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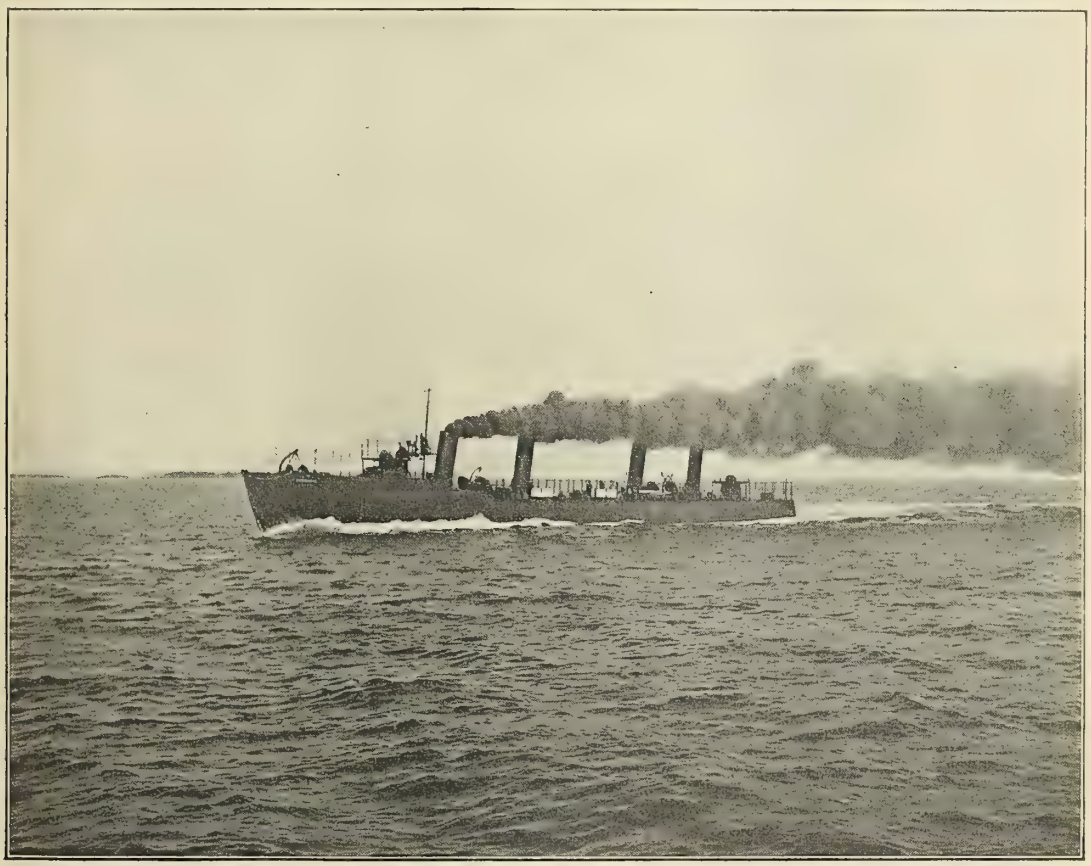
Marine Engineering

Vol. 7. NEW YORK, NOVEMBER, 1902. No. 11.

TRIALS OF THE UNITED STATES TORPEDO-BOAT DESTROYERS BAINBRIDGE, BARRY, AND CHAUNCEY.

The three torpedo-boat destroyers *Bainbridge, Barry,* and *Chauncey,* which were built by the Neafie and Levy Ship and Engine Building Company, of Philadelphia, Pa., have all successfully passed their acceptance trials and are about to be delivered to the Government at the League Island Navy Yard. These three destroyers are from the same general plans and specifications furnished by the Navy Department, and are identical with the two destroyers built by the William R. Trigg Company and the three recently completed at the Union Iron Works. Each vessel has twin screws, driven by four-cylinder, triple-expansion engines, indicating 8,000 I.H.P.

The original contract was for a speed of 29 knots on a displacement of 420 tons; but as both machinery and hull work went considerably above this, a special Board was appointed, who examined the boats and recommended that the trials be modified. The vessels are 460 tons displacement, and the new requirements were that each should run a progressive speed trial and standardize the propellers to a speed of at least 28 knots, and run one hour at a speed of 26 knots, with full contract weights on board and complete in every respect. Under these conditions the boats easily fulfilled the requirements.



U. S. TORPEDO-BOAT DESTROYER BAINBRIDGE WHILE ON TRIAL MAKING 29 KNOTS.

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The following tables give the results and conditions of the trials. The pressures recorded are the average from the mean of three readings, taken during each run by the Board. The number of turns are the mean averages per minute, and were recorded by counters placed on deck, which, at a signal, were thrown in gear at the moment of entering the course, and out of gear at the finish of each run. The difference in time and slip are for the runs with and against the tide. The Board required that four double runs be made over

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OFFICIAL STANDARDIZATION TRIALS: BARREN ISLAND COURSE.

Bainbridge: Displacement 460 tons at start, safety valves lifted at 235 pounds. September 11, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 31.5	270.1	135	¾ in.	¾ in.	23.76		15.81	
1 North..	2 36.2	271.4	135	¾ "	1 "	23.05	23.41	18.73	17.27
2 South..	2 16.2	301.7	180	2 ins.	1¾ ins.	26.43		16.17	
2 North..	2 23.5	299.6	176	1¾ "	1¾ "	25.08	25.76	19.85	18 01
3 South..	2 13	312.9	195	4 "	2¾ "	27.06		17.19	
3 North..	2 16.2	313.5	198	2 "	3¾ "	26 43	26.75	19.30	18 25
4 South..	2 04.5	334.4	230	6 "	6¾ "	28.82		17.49	
4 North..	2 08.2	334.7	230	6 "	7¼ "	28.08	28.45	19.69	18.59

Barry: Displacement 461.6 tons at start. August 27, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 32.1	254	125	1½ ins.	1¾ ins.	23.67		16.58	
1 North..	2 38	251	130	⅞ in.	¼ in.	22.78	23.22	21.95	19.26
2 South..	2 15.3	287	180	2¾ ins.	2¾ ins.	26.61		17.04	
2 North..	2 26.1	284.6	180	2¾ "	2¾ "	24.64	25.62	22 50	19.27
3 South..	2 10.2	300.5	212	6 "	2 "	27.65		17.65	
3 North..	2 16.2	306.8	210	6 "	3 "	26.43	27.04	23 09	20.32
4 South..	2 07	321	240	7¼ "	7 "	28.35		21.25	
4 North..	2 09	327	240	7½ "	7 "	27.91	28 13	23 62	22.43*

*A slight derangement in steering gear on 4th run reduced the speed and increased slip.

Chauncey: Displacement 463 tons at start. August 12, 1902.

Runs.	Time on Course.	Revs. per M. Mean.	Steam at Eng.	Air Pressure in Fire Room.		Speed, Knots.	Mean Speed.	Slip.	Mean Slip.
	M. S.		Lbs.	For'd.	Aft.				
1 South..	2 33.1	256.7	135	⅞ in.	¼ in.	23.5		16.75	
1 North..	2 43.2	254.4	139	⅞ "	⅜ "	22.07	22.79	21.16	18 95
2 South..	2 22	277.5	175	1½ ins.	2¼ ins	25.35		17.00	
2 North..	2 27.4	284.2	172	1½ "	2¼ "	24.42	24.88	21.93	19,46
3 South..	2 08	312.3	220	4¼ "	4¼ "	28 13		20.58	
3 North..	2 13.7	313.4	221	3 "	3 "	26.93	27.53	21.99	21.28
4 South..	2 02	328.8	248	8 "	8½ "	29 51		18.49	
4 North..	2 09.6	326.3	240	7 "	7½ "	27.77	28.64	22.65	20.57

NAME—Chauncey. NATIONALITY—American. BUILDER—Neafie and Levy Co.
TYPE—Torpedo-boat Destroyer. LAUNCHED—1901. OWNER—U. S. Government.

Length over all..... 250 ft. 3 ins.
Beam, extreme ..... 23 " 9 "
Depth..... 14 " 3 "
Draft, forward ..... 5 " 6 "
" aft..... 8 " 9 "
Displacement, trial.....463 tons
Block coef..... .41
Midship coef..... .77
Prism. " ..... .53
Bunker capacity..... .....212 tons
Propellers, number 2
No. of blades..... 3
Diameter ..... 8 ft.
Pitch.....11 ft. 2 ins.

Pitch ratio 1.4
Developed area..... .....24.2
Ratio " 478
Tons per inch, L. W. L.....10.05
Cent. of grav. of L. W. L. aft.....7.5 ft.
Cent. of buoy. above bot. of keel.....4.6 "
Number of frames 140

Trials.

R. P. M..... .....328.8
I. H. P..... 7,800
Speed. ..... 28.7 knots
Slip .....20½ per cent.
Boiler pressure..... .....250 lbs.
Coal per I. H. P.....2.5 lbs.

NAME—Chauncey. NATIONALITY—American. BUILDER—Neafie and Levy Co.
TYPE—Torpedo-boat Destroyer. LAUNCHED—1901. OWNER—U. S. Government.

Engines, number.....2
Type..... four-cylinder, triple
Cylinder diam.....20½, 32, 38, 38 ins.
Valves ..... double-ported piston.
Sizes ..... one 12 in., two 13-in., four 13-in.
Stroke ..... 22 ins.
Designed R. P. M 225
" I. H. P.....8,000
" speed.....28 knots
Area condens. surf.....6,040 sq ft.
" thrust " .....1,128 sq. ins.
Diam. pis. rod ..... Out, 4¼ in.; hole, 2¾ ins.
" con. " ..... Up, 3⅞ ins.; low, 4⅝ "
" " " ..... Hole, 2½ ins.
Length " " .....46¾ ins.
Diam. crank pin..... Out., 8½ ins.; hole, 4¾ "
Length " " .....12 "
Diam. crank shaft.... Out, 8½ ins.; hole, 4¾ "
Length main jour.....13, 14, 12, 13, 9½, 9½, 9½ "
Area guide surf., each..... 176 sq ins.
Length cr. hd. pin 8½
Diam. " " " .... Out., 5¼ ins.; hole, 2½ ins.

Air-Pump.
Type .....Double-Acting Bailey
Diameter.....12 ins.

Stroke.....6 ins.
Volume..... 169.6 cu. "
Boilers, number of.....4
Pressure.....250 lbs.
Type..... Thornycroft-Daring
Length casing..... 10 ft. 2 ins.
Breadth ..... 15 " 6 "
Height ..... 10 " 2 "
Length of grates.....7 ft.
G. S.....315 sq ft.
H. S.....17,768 sq ft.
Draft.....6 to 7 ins water
Fans four, 54 ins in diam. by 14 ins wide
H. S. ÷ G. S.....56 4
H. S. ÷ I. H. P..... 2 22
I. H. P. ÷ G. S. 25.4

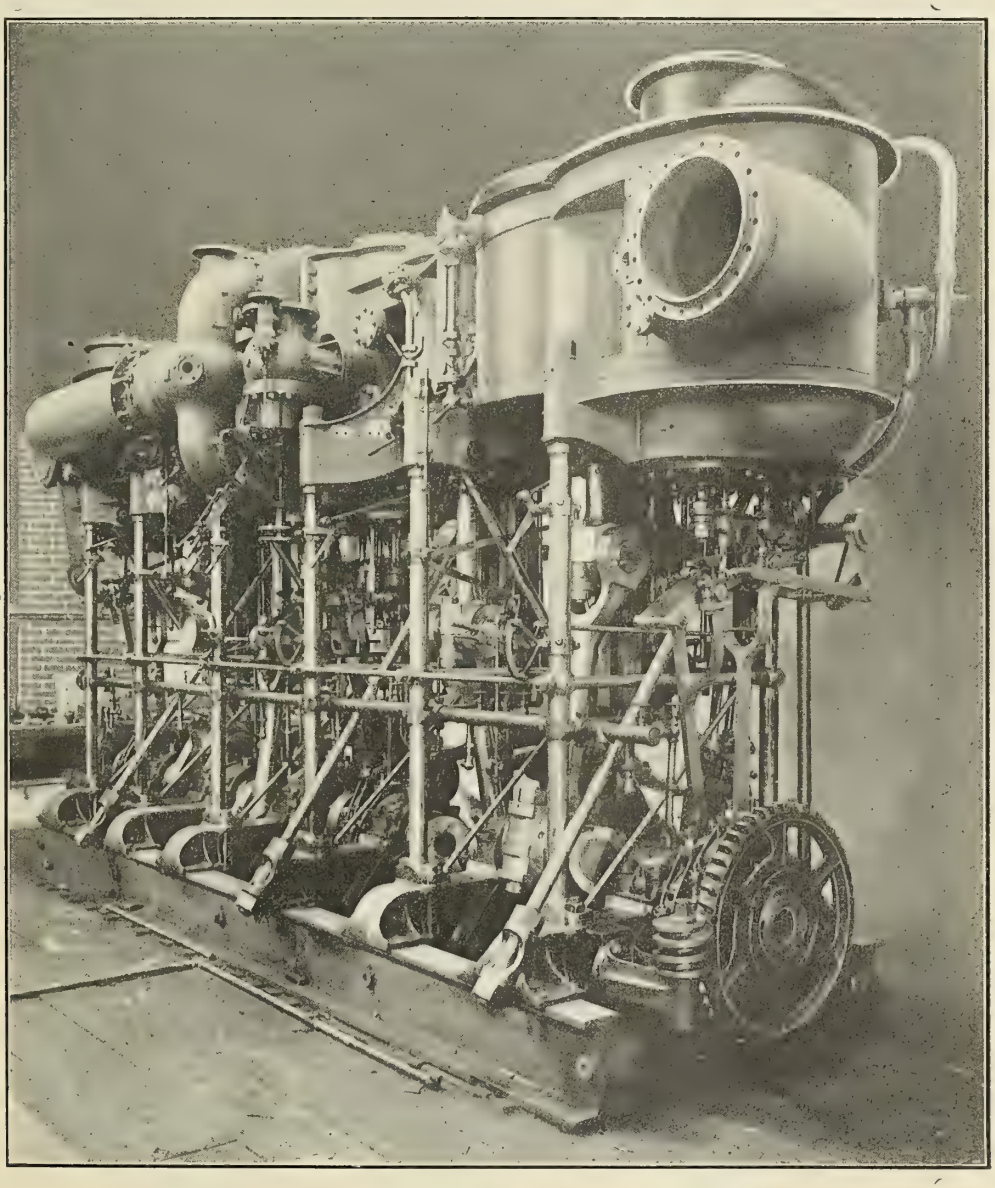
Weights.
Engine, total ....196,000 lbs.
" per I. H. P..... .....24.5 "
Boilers, dry..... .....222,000 "
Boilers, total ....236,000 "
" per I. H. P.....29.5 "
Machinery, total .....418.000 "
" per I. H. P. ..... 52.3 "

the measured course at speeds as near as possible to 22, 25, 27, and not less than 28 knots. The throttles were carried wide open and the steam pressure in the boilers regulated to suit the different speeds.

The method of determining the revolutions required for the true speed of 26 knots an hour was by plotting a curve, the mean of the two curves drawn for the speed and revolution with and against the tide. It was then found that the *Bainbridge* would have to make 303 mean average turns; the *Barry*, 292; and the *Chauncey*, 294 turns. This difference is on account of the variation of the pitch of the propellers. On the one-hour trial no attempt was made for high speed. Ten turns in excess of the requirements, or .9 of a knot on a steam pressure of 200 pounds and an air pressure in the fire rooms of about 3 1-2 inches, were attained. "Run of the mine" Pocahontas coal was used on all the trials. The crew came from the builders' yard, and the boilers were fired by steamship firemen secured from New York. The crew, all told, numbered forty-eight men.

As several long runs had to be made to and from the trial course, there was a good chance of testing the sea-going qualities of the boats and also of learning the coal consumption. At a speed of 12 knots, and with natural draft, about 1,650 pounds of coal were burned per hour with two boilers in service. With the same number of boilers and 1-inch air pressure, a speed of 18 knots was attained on 1 1-2 tons of coal.

The three vessels were built side by side on the stocks, as shown in the accompanying engraving, and were launched complete with steam up. The boilers were tested with both water and steam after they were placed on board, and the engines and piping were also tested before covering. After each vessel had been launched the shafting was carefully tried, and no



ONE OF THE FOUR-CYLINDER TRIPLE-EXPANSION ENGINES, U. S. TORPEDO BOAT CHAUNCEY.

change from the original line was found. The bearings ran well on all the trials and were afterward lifted for inspection by the chief officer of the Trial Board. Two hours after the *Barry* was launched, which time was required to remove the packing from under her, she proceeded down the river fifteen miles and back. Everything worked satisfactorily, and a few days after this the vessel went down the river again on half power. She then proceeded to the trial course in Chesapeake Bay, and had one run of forty minutes before undertaking her official trials, which were passed successfully.

THREE TORPEDO-BOAT DESTROYERS WHILE BUILDING AT THE YARD OF NEAFIE AND LEVY SHIP AND ENGINE BUILDING COMPANY.

THE CARD INDEX SYSTEM.

The card index system is becoming very popular with engineers and draftsmen, and it may soon take the place of the once necessary note book. Its flexibility and the readiness with which it is kept up to date are the leading features of attraction. The author has developed one that has proved practical and useful, and he has grown so enthusiastic over it that he believes a description of the leading features may be of interest to others who are desirous of compiling information in a convenient form.

The cards used are 4 inches by 5 inches, both blank and plain ruled. They are indexed very simply, according to subject only, with few cross references. To begin with, formulæ for calculation are copied and filed—not standard, well-known formulæ, as for beams, or Lloyds, etc., but such useful formulæ as one comes across in good technical reading, or such as one may derive himself. The source of all data should always be given, as data without positive authority for its existence will not be recognized in reputable engineering offices.

Sketches form another important division of the card index system. They may be freehand or scale drawings. In this work the usual mistake is to accumulate too much useless matter on the start. No sketch should be filed without it has some special or standard point of merit. It is a mistake to sketch everything haphazard. In connection with this the kodak may be used with valuable results. Use a plate or film the same size as the card. The 4-inch by 5-inch is advised for both. Machinery, ships, details, large drawings, methods of hoisting, and interesting accidents can be photographed on the spot, and the print filed with the data on the back. With this data should be given the number and other information necessary to find the negative. Velox is the best for all-around work of this kind. A sheet or two of good blue-print paper may be cut up into cards, and on this prints can be made from parts of large drawings which have special features desirable to note. Indicator cards may be taken on thin paper and then printed through on these, to save for future reference. The scales must be measured off and marked before printing, as the blue-print paper will shrink and stretch.

Many times one wishes to keep clippings of drawings or engravings of machinery, fixtures, inventions, etc. One hesitates to spoil his file of papers, and yet hates to buy extra papers to cut up. The following works beautifully: Make a solution of alcohol saturated with clean sal soda, then add one-tenth, by measurement, of fine, clean, powdered shellac. Spread this solution on the picture desired. Lay a blank card over it and rub the card with a warm flatiron. Then carefully lift the card. The picture will be beautifully transferred to the card, with still enough left on the magazine to be

perfectly clear. Of course it will be reversed, but this seldom matters. By these methods full and very complete data, with photos, etc., may be filed of the building of a ship, her engines, boilers, propellers, tests, materials, and appearance. The full data of her trial may also be filed systematically and clearly.

One can file, for comparison, data pertaining to valve gear, cards, combined cards, various curves, the more abstruse and mathematical data pertaining to a particular piece of machinery, that the designer may have all this to refer to when he has occasion to make comparisons.

Also cards may be cut from cross-section paper, and in miniature these will serve to preserve the curves used in calculations. For instance, the curve of thrust for a given ship is useful to have for comparison with the next ship in order to judge what has been attained in a comparative way.

When one is sightseeing he should be supplied with sketchbook and rule or kodak. Of course reference is made to sightseeing in the machinery line only, as one of the best sources of information for the card system is what a person sees and hears. For instance, the writer once inspected and was much interested in a forced-draft system which an ingenious mill foreman had gotten up to assist in burning wet redwood sawdust and slabs. The information and remarks were put on one card, a sketch of the tuyeres on another, a skeleton sketch of the piping and blower on a third, and a photograph of the plant on a fourth. From these four cards the plant could be successfully installed by one who had never seen it.

Of equal, if not greater, importance than what an engineer sees and experiences is what he reads. His periodicals, his books, the literature from his various societies, and the great number of handsome, instructive catalogues will all furnish valuable material. For example, the various formulæ for flat plates to resist pressure, the standard forms of Corliss gears with drawings, sketches of different systems of oil burning and data, valuable tests of bursting point of flywheels, etc.

The value of advertisements is underestimated by many. Recently an engineer, in looking in his card system, saw "How to condense with a small amount of water, new idea." Looking up the reference, he found that it was the now well-known system of surface condensing with a spray and blower. The idea he had seen in an advertisement, and it happened to particularly suit the wants of his client, and a neat compensation was his reward.

It can be readily seen that such a card system would take the place of the pocket or note book. It is not an index system, for it is the note book in itself and never ceases to grow.

As to methods of indexing, cross references should be avoided except where especially desirable. It is best to arrange according to name of largest conglomeration, as "Steamship *Korea*" or "Waterside Power Station." Then if a man wants, for instance, a good design for 80-inch cast-steel steam piston, instead of looking in "Pistons," he looks under some job such as would be likely to have a piston of desirable design. But if he finds a piston in his travels or readings of peculiar or special merit, then it, with sketch and data, is filed under head of "Piston."

Cross-section paper cut to card size occupies no mean place in the card index. Curves can be reproduced or data of a run can be thus preserved. Suppose the records of a station are kept on the card index system. A card is marked every thirty minutes with the point showing graphically the load, and another point showing the coal or oil consumed. At the end of the watch the cards are turned in to the clerk, who traces the load curve in black and the fuel curve in red, and it is then filed away for reference, comparison, or used by the consulting engineer for comparison with other stations. This scheme can be carried as far into complex detail as may be desired; and the possibilities of the card system are in evidence at their best in just such a place.

The cards are best filed in a fixed cabinet, many ingenious varieties of which are handled by well-known companies.

The first question in a beginner's mind is, "Shall I retain my note book?" It is not necessary if the card system is carefully classified and labeled envelopes used. These envelopes for indexing can be gotten of any card index company. In them can be kept stray clippings, articles, negatives, samples of emery, polishing compounds, chemical tests, filings, scale, sediment, etc. They should be the same size as the cards and can be filed right among them.

It is well to have a little morocco case that will neatly hold and protect at least fifty cards, in order that those relating to any given subject or group of subjects may be carried in the pocket for reference when required. Suppose one is installing or figuring to install a centrifugal pump, and has to see the pump or talk with the customer frequently. It would be well to have his available data and former estimates in his pocket, that he might drop into a quiet corner and consult them if perplexed. Memory cannot be absolute.

Added to this we now have the Card Index Magazine, which may grow enormously. It is mailed to us, with data of ships and engines printed, all ready to file for future reference.

Large drawings in the engineer's office must be classified with the books and periodicals of which the cards are the index. They can be filed according to any of the approved drawing-room and library systems; but the object of the card system ends with the ability to ease the burden on memory, systematize technical data, constantly eliminate that which is obsolete and be able to utilize the remainder at a moment's notice and to the best advantage.

Battleship Plant.—The electrical equipment of the battleship *Connecticut* consists of eight 100-K. W. steam-driven generating sets of 125 volts. There will be six electrically-driven generators to supply current to the turret-turning motors; eleven hundred electric fixtures complete; ten enclosed arc lamps for engine and boiler rooms; six 30-inch searchlights; two truck lights; electric night signaling sets; divers' lamps, ventilating sets, etc.

GAS ENGINES AND THEIR TROUBLES.—VI.

BY E. W. ROBERTS.

Installation.

There are quite a number of different ways of installing a gas engine in a boat, although the same general plan is usually followed. This is to place the engine either aft or amidships, with the fuel tank in the bow, so that the gasoline flows by gravity to a vaporizer placed as low down as possible near the engine. There are variations of this method, induced by some special arrangement of the interior or by the purpose for which the boat is intended. Sometimes, for instance, the gasoline tank is placed in the stern just under the after deck, and again it is placed beneath the floor in an air-tight tank and air pressure employed to raise the fuel to the vaporizer. In the smaller craft the engine is usually placed clear aft and at a considerable inclination. The latest practice, however, for boats of 30 feet or over using heavy engines, is to place them amidships, while in some cases the engines have been placed clear forward, as, for instance, in some of the later speed launches.

Taking first the case of installation as ordinarily employed and shown in Fig. 25, the general scheme is indicated for a small boat in which a single-cylinder, four-cycle engine is installed amidships. The plan shown is that for a boat of about 20 feet length by 5 feet 3 inches beam, with a 5-inch by 6-inch engine. Starting at the bow, the gasoline tank, with a capacity for about twenty gallons, is placed under the forward seat or deck, as the case may be. This tank should be of galvanized iron or copper, carefully soldered, and tested with gasoline to see that there are no leaks. In the top of the tank is placed a filling plug of brass, and in this plug should be drilled, according to the usual practice, a hole about 1-8 inch diameter as a vent. While it is the usual practice to put a vent in the plug, the writer believes it unnecessary, as he has run gasoline engines with tightly-closed tanks, without experiencing any trouble whatever. If the tank is tied by rods passing straight through it horizontally both forward and athwartships and about half way up the tank, it will stiffen it and avoid the snapping which is sometimes experienced with thin metal. These rods should be riveted on the outside and the hole carefully soldered. These rods will also avoid bursting the tank from rise of pressure due to overheating and consequent generation of vapor. In extremely hot climates, as, for instance, in Australia, it might be necessary to use a vent in order to prevent bursting of the tank. The space in which the tank is placed should be well ventilated, in order that all gasoline vapor escaping from the tank may be carried away and not allowed to accumulate.

From the gasoline tank the liquid is carried to the engine through a valve, as indicated, the connection to the tank being made at least 1-2 inch from the bottom in order to prevent any sediment which may find its way into the tank from getting into the pipe. The bottom of the tank, as shown in the figure, should have a slight inclination aft, so that it may be well drained. To the valve should be attached a lead pipe leading to the engine, and the joint between the pipe and the valve should be a good wipe joint, made by an experienced plumber, as should also be the connection at the vaporizer. Lead pipe is preferable for several reasons. It is quite easy to bend it in and around corners, and bending it is not likely to produce a leak, as would be the case with iron pipe. Again, iron pipe is very apt to have cracks which do not always develop when first connected. It is exceedingly important that leaks into enclosed spaces of the boat should be avoided. These leaks occasion a collection of gasoline vapor mixed with air, which makes a dangerous explosive. With some builders it is the practice to enclose the lead pipe in an outer casing of iron pipe, thus making it more secure against leakage. Placing the vaporizer low avoids the use of a pump, although the gasoline pump is sometimes employed with a vaporizer and an auxiliary reservoir near the top of the engine.

There are two very important points to consider in building the foundation for the engine. In the first place, the engine must be firmly attached to the foundation and the foundation to the boat, so that it will not be easily torn loose. Again, the strain should be distributed over a large surface, in order to avoid swaying of the engine and a racking strain upon the boat. A very common method is to place the engine upon two sister keelsons, which extend quite a distance fore and aft and are firmly braced. In a comparatively large and stanchly-built craft this method is a good one, especially if the engine is bolted to the foundation by a plate at the bottom of the base. It is quite common practice to bolt an engine to the sister keelsons with lag screws, but this method the writer does not consider a good one, as the wood is likely to rot around the lag screws, allowing them to pull out. Wherever the construction of the foundation will allow it, through bolts should be employed, with washers of a generous size wherever the bolt is drawn against wood.

The engine shown in the figure is bolted to the foundation by means of lugs at the center of the crank case, in order to save the mass of metal usually required for a foundation base. As the bolt is a light one, the four floor beams indicated are first laid, and to these are bolted two stout oak sills, thus distributing the weight over a considerable portion of the bottom. If these sills are well put in, no side braces, as are sometimes used, will be found necessary. Every marine engine should be provided with a water pump for forcing water through the jacket. The water is usually drawn through the bottom near the keel, the end of the suction pipe being covered with a strainer to prevent choking the pump. The pump suction might be also connected with a pipe leading to the bottom of the boat for pumping out the bilge. Each of these suction pipes should be provided with a cock, of which one—the sea cock—is indicated in the figure. The bilge pipe will be found more convenient if it has attached to it a length of rubber hose that may be carried to suck different parts of the boat as may be filled with water. Under no circumstances should the bilge cock and the sea cock be left open when leaving the boat for any length of time. Should both cocks be left open, water is very likely to siphon in from the sea and out through the bilge pipe, swamping the boat.

From the pump the water usually passes to the jacket at a point near the bottom, and thence out through a pipe at the top of the cylinder to an outlet above the

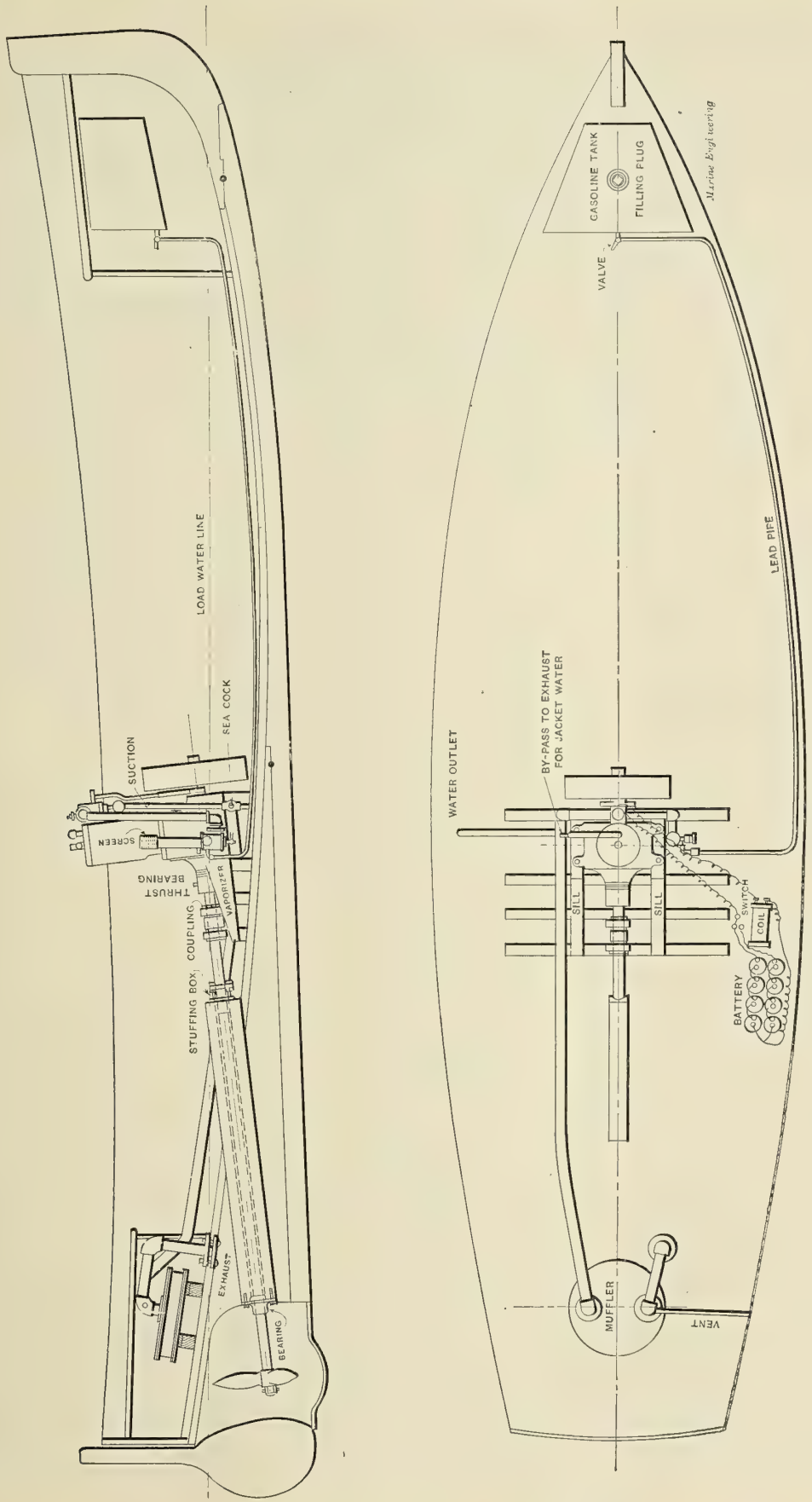


FIG. 25.—ARRANGEMENT OF MACHINERY AND PIPING FOR A GASOLINE LAUNCH.

water line, ordinarily just beneath the top strake. Not always, but quite frequently, a portion of this water is allowed to pass into the muffler, the amount being usually just what the heat of the exhaust will evaporate, and not sufficient to flood the muffler. This water not only keeps the muffler cool, but also assists in reducing the noise by condensing a portion of the exhaust gases.

The plan of connecting up the exhaust pipe shows the latest practice, the muffler in this case being of the shape of a snare drum. There is nothing at all mysterious about this muffler; it is nothing more nor less than an expansion chamber. This particular muffler consists of a cast-iron ring, to each side of which is bolted a flat plate of boiler iron. The entire device is so designed as to withstand a pressure of 100 pounds per square inch in order to provide for explosions that might accidentally take place therein. The shape of the muffler is usually made to conform to the space occupied, and if this is such as to allow of a simple cylinder of extra-heavy stovepipe iron, this will make a very light muffler for a small engine. The exhaust enters at one side of the muffler, as shown, whence it passes downward to a point just below the water line. In order to avoid water being drawn into the muffler from the sea should a vacuum be formed when the engine is stopped, a small vent is run from the muffler to a point above the water line. This vent should always be employed when the exhaust is beneath the water. The reader should note that the under-water exhaust is carried only two or three inches beneath the water surface, otherwise there would be excessive pressure on the engine, thereby reducing its power. This greatly aids in decreasing the noise and also destroys much of the disagreeable odor of the exhaust gases.

Returning to the engine, the connection to the propeller shaft is made with any good form of coupling, a compression coupling being that shown in the illustration. A ball or a roller thrust bearing should be placed immediately back of the main bearing of the engine, and on some engines now on the market this is part of the regular equipment. The propeller shaft passes outward through a shaft log with a good form of stuffing box at one end and a bearing at the other. Practice varies as to which end of the shaft log the stuffing box should be placed, but it will be found most convenient if placed inside the boat. The equipment illustrated in Fig. 25 has the engine coupled directly to a solid propeller without a reversing mechanism. This does very well for a small boat, if it is not used on a crowded waterway. Where a reversing mechanism is in frequent demand, either a reversing propeller or a reversing clutch may be used. Where there is room to spare inside the boat the reversing clutch is to be preferred, as the solid propeller is quite a little more efficient than one with reversible blades. However, when the engine is placed very far aft there is usually no room for a reversing mechanism, and a reversing propeller becomes necessary. In at least one make of two-cycle engine the engine itself is made to reverse by manipulating the spark lead. In this case, of course, no reversing propeller or clutch is necessary.

With large engines having a number of cylinders the latest practice is to place the engine shaft parallel with the keel and to use universal couplings between the engine crank shaft and the propeller shaft. This necessitates at least one pillow block for the inner end of the propeller shaft. If the engine be very large, the thrust bearing is put back of this pillow block, as well as behind the after-engine bearing, the reversing mechanism being placed just aft of the engine.

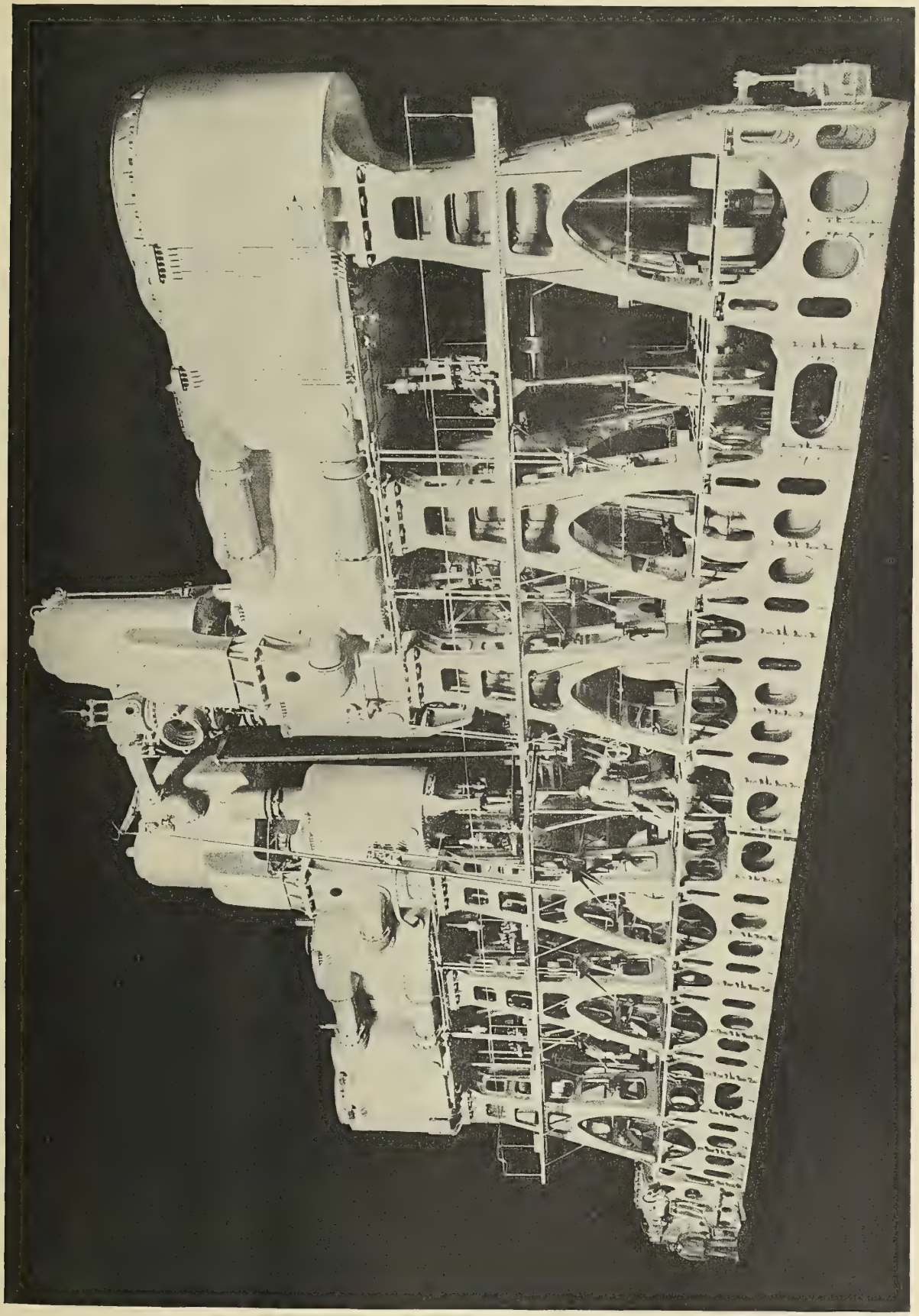
The question of electrical connections was quite thoroughly discussed in the third number of this series; therefore it will be unnecessary to consider it further here. In the figure are shown two batteries of four cells each, both positive poles being wired together and to the spark coil. The negative poles are connected to two terminals of a three-point switch, and wires are led from the switch and from the coil to igniter terminals on the engine. It is best to connect the negative electrode of a dry battery to the ground on the engine, rather than to the insulated point, since the case of the battery is generally composed of zinc and forms the negative side. With this manner of connection, should the battery in any way become grounded a short circuit would not occur. Both the battery and the coil should be placed in the dryest part of the boat and, if necessary, in a water-tight box, as excessive moisture destroys the efficiency of both the coil and of the battery.

(To be continued.)

Engines of the Kaiser Wilhelm II.

The power for driving the modern transatlantic liner is still on the increase, as is seen from the data of the engines for the new North German Lloyd express steamer *Kaiser Wilhelm II.*, which was recently launched by the Vulcan Shipyard, Germany. The machinery consists of four three-crank, quadruple-expansion, four-cylinder engines—two mounted on each shaft. The estimated indicated horse power of the four is from 38,000 to 40,000. For the double purpose of reducing the amount of power in one unit and cutting in two the possibility of a complete breakdown, there are two separate engines on each shaft, and each engine is placed in a water-tight compartment with its own auxiliaries.

The accompanying illustration, which is reproduced from the London *Engineering*, is taken from a photograph of two of the units. The high-pressure cylinder is mounted above the first intermediate cylinder; adjoining the latter is the second intermediate, and next comes the low-pressure cylinder. The diameters of these are, respectively, 37.4, 49.2, 74.8, and 112.2 inches, and the common stroke is 70.8 inches. The engines are balanced according to the Schlick system, and the two tandem engines are to be placed next to each other, with a bulkhead between. Ordinarily the two engines on one shaft will be operated from the forward engine room platform, but the levers are so arranged that the engines may be controlled from the after engine room, or each engine may be operated from its own compartment. As above stated, there is a complete set of auxiliaries for each engine, each engine room being self-contained, having one condenser of 11,732 square feet of cooling surface, one centrifugal pump, one Weir air pump, one single Weir heater and feed pump, and one double Weir boiler feed pump. There are also arranged in each engine room two independent duplex pumps.



DOUBLE QUADRUPLE-EXPANSION ENGINES FOR NORTH GERMAN LLOYD EXPRESS STEAMER KAISER WILHELM II.

The engines are designed to make 80 revolutions per minute, driving a four-bladed bronze propeller 22 feet 9.6 inches in diameter. The crank and thrust shafts are made of the best nickel steel, that of the forward engine being 20.87 inches in diameter, and of the after one, 25 inches in diameter. The propeller shaft is of crucible steel, 25.4 inches, and the line shafting is made of Siemens-Martin steel. The total number of engines on board, including the main engines, is seventy-nine, and there are one hundred and twenty-four steam cylinders.

Steam is to be supplied by twelve double-end and seven single-end Scotch boilers, with a total of 3,121 square feet of grate surface and 107,643 square feet of heating surface. Although natural draft is to be used, the boiler rooms are supplied with air from the deck above by eight fans when natural draft is not sufficient. The arrangement of the boiler rooms is such as to facilitate the transporting of coal to the boilers, and will be described in a later number. In the after boiler room are three double-end boilers, and in the next forward are three double-end and three single-end; in the third boiler room are three single-end and three double-end, and in the fourth boiler room are placed three double-end and one single-end boilers. In each boiler room will be a large feed pump and two ash ejectors, a steam ash hoist for use when in harbor, and other necessary apparatus. A ballast pump is also placed in the third boiler room.

LAUNCHES.

Tugboat Portland.—A handsome new tugboat, *Portland,* which has been built for the Central Wharf Towboat Company, was recently launched from the Portland Shipbuilding Company's yard at South Portland, Me. The tug is 93 feet 6 inches long, 20 feet beam, 10 feet 6 inches draft at full load. She will be driven by a compound engine with cylinders 14 and 30 inches in diameter by 20 inches stroke. This tug is designed for ocean-going as well as for coastwise work, and is sufficiently powerful to tow the largest steamers.

Steamship Arizonan.—The big freight steamer *Arizonan,* built by the Union Iron Works, San Francisco, Cal., for the American-Hawaiian Steamship Company, was successfully launched on September 20. The vessel is of 8,672 gross tons, measuring 486.5 feet over all, 57 feet breadth, and 32 feet depth. She is propelled by two quadruple-expansion engines with cylinders 21, 28, 38, and 60 inches by 36 inches stroke. Steam is supplied at 213 pounds working pressure by three single-end boilers 10 feet 4 inches long by 14 feet 3 inches diameter, provided with forced draft.

Steamer Muncie.—A fine package freight steamer was launched from the yards of the Detroit Shipbuilding Company, Wyandotte, Mich., on September 20. The vessel was christened the *Muncie* and is for the Anchor Line. The steamer is 372 feet in length over all, 350 feet length on keel, 46 feet beam, and 30 feet deep. Steam is supplied by three Scotch boilers, each 11 1-2 feet in diameter by 11 1-2 feet long, working at a pressure of 210 pounds. The engine is a quadruple with cylinders 19, 27, 40, and 58 inches diameter by 42 inches stroke. Her carrying capacity will be 5,000 gross tons, and it is stated she cost $290,000.

Steamship Texan.—The last of the three sister ships for the American-Hawaiian Steamship Company was successfully launched from the yard of the New York Shipbuilding Company, Camden, N. J., on August 16. The dimensions of the vessel are as follows: Length over all, 484 feet 3 inches; beam, molded, 57 feet; depth, molded, 42 feet 6 inches. Her displacement will be over 16,000 tons, and her carrying capacity is 11,000 tons.

Steam Yacht Coranto.—There was recently launched at Morris Heights the steel steam yacht *Coranto,* built from designs by Gardner and Cox for Mr. A. E. Austin, of Providence. The yacht is 155 feet long over all, 120 feet on water line, 20 feet beam, 12 feet 6 inches deep, and has a draft of 8 feet 6 inches. The owner's quarters, including four single and two double state rooms, with two bath rooms, all handsomely finished in white pine, mahogany trimmed, are located aft the engine room. The vessel is propelled by a triple-expansion engine with cylinders 11, 16, and 26 inches in diameter, with 15-inch stroke, and is supplied with steam by a Seabury water-tube boiler.

Mexican Gunboats.—Two gunboats, named the *Vera Cruz* and *Tampico,* were launched from the Crescent Shipbuilding Company, Elizabethport, N. J., on September 15, and are built to the order of the Mexican Government. The new ships are of the following dimensions: Length over all, 201 feet 6 inches; length between perpendiculars, 198 feet; breadth, molded, 32 feet 10 inches; depth, 15 feet 8 inches; draft, loaded, 10 feet; displacement, 980 tons. The vessels will be propelled at a maximum speed of 16 knots by two triple-expansion engines with cylinders 14, 22, and 36 inches in diameter by 24 inches stroke. In the boiler room, which is of the closed-stokehole type, are two 48-inch blowers with forced draft. The boilers are of the Mosher water-tube type, with grate surface of 81 square feet, designed for 250 pounds working pressure. The armament of each vessel consists of four 4-inch rapid-fire guns, one mounted on the forecastle, two in the waist, and one on the poop; four 6-pounders and one torpedo tube.

U. S. Cruiser Des Moines.—On September 20 the U. S. protected cruiser *Des Moines* was successfully launched at the Fore River yard, near Boston. The ship is one of the six sheathed and coppered cruisers purchased by act of Congress March 3, 1899. The contract was signed by the Fore River Ship and Engine Building Company, Quincy, Mass., on December 14, and the keel was laid August 28, 1900. The *Des Moines* has a load water line of 292 feet, an extreme length of 308 feet 2 inches, breadth of 44 feet, mean draft of 15 feet 9 inches, normal displacement of 3,200 tons, with a load displacement of 3,500 tons. The estimated speed with the engines indicating 4,700 horse power would be 16 1-2 knots; coal supply is, normal 467 tons, maximum 700 tons, giving a radius of 9,800 miles at 10 knots. The machinery consists of two 4-cylinder triple-expansion engines and six water-tube boilers. The diameters of the cylinders are 18, 29, 35 1-4 inches by 30 inches stroke. The grate surface is 300 square feet. The main battery will consist of ten 5-inch 50-caliber B.L.R., and the second battery comprises eight 6-pounders, two 1-pounder R.F.G., four Colt automatic guns, and one 3-inch field gun.

OPPORTUNITIES FOR ENTERING ENGINE-ROOM SERVICE.

So many inquiries have been of late received at the office of Marine Engineering from young men who desire to secure positions in the engine rooms on steamships that letters have been sent to the leading steamship companies of our coasts and Great Lakes, asking what are the requirements for entering this service. Also, we have made inquiry of the Revenue Cutter Service, and find that there are at present four vacancies in the list of second assistant engineers. A most interesting file of replies was received from the superintending engineers, and in general the tone was encouraging to young men who wish to become marine engineers. To classify the answers we have divided them under three headings: (1) Sea Service, (2) Service on the Great Lakes, and (3) Government Service.

Under the first class, in all but one of the companies written to, the superintendents are on the lookout for capable young men to start in the service. The requirements for entering the service differ somewhat, some superintendents stating that oilers are chosen from among the firemen and that the engineers are selected from oilers who hold engineers' certificates. In other lines it is the custom to select most of the oilers from a different class of men than those who serve as firemen.

In these positions, as elsewhere, it is evident that many of the men are anxious to get along too fast, for in one of the letters we find a hesitancy on the part of a superintendent to employ young men for this reason. In one instance the engineer must have five years' machine-shop experience before he becomes eligible, and in another case shipyard experience is the requisite. Generally speaking, in all the lines promotion is slow, and most of the superintendents prefer to encourage the good work of the firemen by promoting them to the position of oilers. On two of the lines the ships carry a limited number of cadets from fifteen to twenty-one years of age. These young men must have two years' experience in the machine shop, and it is found that those who are brought up in the country as farm hands are much better suited for the strenuous work in the fire and engine rooms than the city-bred boy. The general appearance and habits of the man count largely wherever a position of responsibility is to be filled.

The pay for beginners is about the same in all of the companies. In the two lines mentioned, where cadets are taken, the pay for the first month is $10. The pay of the coal passers is from $25 to $35; that of the firemen, from $35 to $40; oilers and water tenders, from $35 to $45; and assistant engineers, $80 and up.

In a word, there are excellent opportunities for the right class of young men, who are willing to begin at the bottom and work up. If they start in as firemen, they must be in first-class physical condition, for we know of no work which is more trying than that of firing on the modern Atlantic express steamer.

Following are extracts from some of the answers received:

No. 1. Southern Pacific Company, New York:

We do not accept young men without previous sea experience in the engine room. Application should be made by letter to the chief engineer. Applicants must have fair education, some mechanical training, and must be healthy. First-class machinists or boilermakers are preferable. The pay for oilers and water tenders is $45 a month. J. T. Vansickle, Agent.

No. 2. International Navigation Company, New York:

Application is made to the superintending engineer on a printed blank which may be had by writing to the company. The rule in this company is that all engineers shall work up from the lower positions, and that any engineer joining the company must be at least a first-class machinist, which means that he must have served a regular apprenticeship of not less than three years at the building or repairing of engines. Any boy starting out with a good public school education is sufficiently well equipped to enable him to acquire all the engineering education he will need to obtain the necessary licenses required by the Government in order to get positions higher than juniors. It is, however, as you know, to the benefit of the boy to have a good engineering education before going to sea. James Carnegie, Supt. Engineer.

American Line. Red Star Line.

APPLICATION FOR EMPLOYMENT.

OFFICE OF

SUPERINTENDING ENGINEER,

Pier 14, N. R., New York.

Jas. Carnegie, *Superintending Engineer.*

Name .....
Age .....
Address .....
Married or single .....
By whom introduced .....
Position sought .....
What certificate held, date and No. .....
In whose employ apprenticeship was served .....
In whose service since expiration of same .....
What positions held? .....
What sea service have you had? .....
Last employers .....
Cause of leaving last situation .....
Has your certificate ever been suspended? .....
Names and addresses of referees .....
Are you a citizen of the United States? .....

.....

(SIGNATURE OF APPLICANT.)

No. 3. New York and Texas Steamship Company, New York:

We are on the lookout at all times for young men who wish to begin at the bottom in the engine room and grow up with the business, but find the great difficulty to be that while they may think that they want to grow up with the business, they want to grow up a great deal faster than the business will warrant, and our object is to have men in our employ who are looking forward all the time to higher positions and will prove they are capable of advancement as fast as the opportunity offers. Applications are made to our marine engineer. The applicants should have a good education, should be in first-class physical condition, and we would like to have them as far advanced as possible. The wages are such as are applied on all

steamers going out of New York. There is very little difference in any of the lines. We find the great difficulty in procuring this kind of men is that the majority of them are not willing to wait until they are thoroughly competent to handle the higher-class jobs, but wish to be advanced very rapidly, and we consider that a man capable to take charge in a large ocean-going vessel should be thoroughly conversant with all the details both in the fire room and engine room.

C. H. Mallory and Company.

No. 4. Maine Steamship Company, New York:

Our engine and fire-room force is composed of men only; we have no class of apprentices. The oilers and engineers are secured from the steadiest men in the fire room. We are very glad to get men of such caliber that they can be advanced. Application should be made to the chief engineer. A green man, of course, would be put in the fire room and would require physical qualifications to enable him to stand the work. The pay of a coal passer is $35 per month; firemen, $40; oilers, $45; and assistant engineers, from $80 up.

No. 5. Boston and Philadelphia Steamship Company, Philadelphia:

It is always our desire to advance men in the engine room, providing they merit it. We have no regular form of application. Simply call in and see the superintending engineer, or address a letter to him. We require an applicant to know how to read and write and to be in good health. Our pay ranges from $25 to $40 per month for beginners. The title of the three positions that we take on beginners to fill are: coal passer, fireman, and oiler. I have filled all the above positions myself, and my advice to young men taking up the engineering branch of a seafaring life is to stick at it, for there are times when one will become discouraged with the unavoidable happenings that go with it. H. B. Vansciver, Supt. Engineer.

No. 6. Old Dominion Steamship Company, New York:

Positions for oilers are, whenever possible, filled by selecting mechanics that have served an apprenticeship in a marine machine shop. Occasionally, however, deserving firemen are promoted to this position. Oilers, when holding a certificate and are competent, are promoted to engineers. An oiler's pay is from $35 to $45 per month. Applications are made to this office.

H. C. Higgins, Supt. Engineer.

No. 7. Quebec Steamship Company, New York:

In the first place, it is necessary for an applicant to have a fair preliminary education; secondly, he must have served a full and regular apprenticeship of five years to the engineering trade in some shop or works where marine repairs or engine building are carried on. Of course, physical conditions and personal appearance are to be considered in selecting engineers for our ships. An engineer applying to this company for an appointment, must make out his application in writing, stating his experience, when and where he has been employed, and confirm same by submitting copies of his testimonials to us. Horace Black, Supt. Engineer.

No. 8. Eastern Steamship Company, Boston:

The chief of each steamer hires his own employees, who are taken from points along our routes. Firemen are paid $35 and oilers $40 a month, increasing as they are promoted. Calvin Austin, V.-P. and Gen. Mgr.

No. 9. Merchants' and Miners' Transportation Company:

Applications are made to the superintendent by letter and in person if possible. Firemen and coal passers are employed directly by the engineers aboard ship, unless it is desired to start some man, and often they are placed aboard by this office. Wages of firemen, $40 per month, and coal passers, $30. Oilers are appointed from this office, and a man's general fitness for the position is considered. His previous experience is looked into and men of experience are given preference. The policy of the company is to promote the oilers to assistant engineers as soon as they become qualified.

J. M. Blankenship, Supt.

No. 10. Pacific Mail Steamship Company, San Francisco:

As a rule the firemen and coal passers are a class of men who by education, surroundings, and station in life are seldom qualified for positions as marine engineers. It is of paramount importance that any one desiring to be a licensed marine engineer must have a thorough knowledge of machinery in all its details, as well as the use and handling of tools in connection with that department. The only place that this can be learned is in the machine shops or engine and shipbuilding plants of the country, and I think I am safe in saying that every United States licensed engineer in our employ has served such an apprenticeship toward qualifying him for his position. There is no place on board the ship where this training can be had. My advice to any young man desiring to become a marine engineer is to first serve a full apprenticeship in some shipbuilding plant. Alex. Center, Gen. Agent.

No. 11. The Pacific Coast Steamship Company, Seattle, Wash.:

Answering your inquiries concerning the opportunity for young men to get employment in the P. C. S. S. Company, would state as follows: The inducements that this company has practiced for the past twenty-five years are steady employment, promotion, and good pay to all employees that serve the company faithfully and well. Every man that accepts a position from the P. C. S. S. Company has it in his power to advance to the highest position in whatever department he may elect to serve in. Applications are usually made to the heads of the departments; engineering department, to the superintendent engineer; deck department, to the port captain. The form used is as per copy enclosed herewith. A good education is one of the essential features for beginners in the engine and deck departments. I would say that the young man with shop training would be better equipped for advancement than the one that did not possess it. Promotions are sometimes slow, and it requires patience to wait until the opportunity comes. Impatience and restlessness have wrecked many ambitious young men striving for promotion.

Physically, I would recommend the strong and healthy for positions on shipboard. Weak stomachs are out of place when rough weather prevails, as the "Professor on Shipboard" will bear me out in this. We have no wage schedule for beginners. Coal passers receive $40 per month; firemen, $50; oilers, $40; water tenders, $55. The young man seeking the information which your letter contains should acquaint himself with the rules and regulations of the U. S. Inspection requirements for

application of engineer's license, also requirements for mates, pilots, and captains.

C. C. Lacey, Consulting Engineer.

Application No.....

PACIFIC COAST STEAMSHIP COMPANY.

APPLICATION FOR EMPLOYMENT.

Date.....190..

1. Full name of applicant .....
(Write given name in full.)
2. Employment desired .....
3. Age ..... 4. Place of birth.....
5. Have you ever been employed before by this Company?.....
6. If so, in what capacity employed?.....
7. If so, where employed?.....
8. If so, give date of entering service.....
9. If so, give date of leaving service.....
10. Reasons for leaving.....
.....
.....
11. Have you any physical ailment or defect which might render you unfit for service you seek?.....
12. Have you ever suffered any physical injury?.....
If so, state particulars.....
.....
.....
.....

Usual signature of applicant.....
Present address .....

I consider the above described applicant a suitable person to enter the Company's regular service. I desire to employ him as .....at or on.....
Effective .....190.. Rate of pay $.....
Approved ....Name and .....Title.

Applicants under 21 years of age must furnish minor's release with application.

(On reverse side is space for stating positions previously held.)

No. 12. Quail's Shipping Office, New York:

Regarding cadets for steamships, it is necessary in the first place that a boy should have at least two years' sea experience for deck cadet and two years' experience in a marine shop for engine-room cadet. He must not smoke cigarettes nor drink rum, and must be between the ages of fifteen and twenty-one years. We find the very best boys are those who have been brought up on a farm, for city boys make very poor steamship cadets.

John H. Quail.

No. 13. Marine Engineers' Beneficial Association, Philadelphia:

Replying to your inquiry, I beg to say that the wages for chief engineers on the coast are from $115 to $150 per month, according to the class of steamer and nature of service; first assistant, $75 to $90; second assistant, $70 to $80; third assistant, $55 to $70; oilers, $45; water tenders, $45; firemen, $40; coal passers, $30; with about the same condition prevailing on the Great Lakes, with the exception that on the Lakes the season is about three months shorter. I am of the opinion that the chances for advancement of young, capable, energetic men are good, and that good positions may result from persistency and faithful application, which are conditions that never fail of recognition.

George Uhler, President.

SERVICE ON THE GREAT LAKES.

Service in the engine room of the steamers on the Great Lakes is somewhat different from that on the coasts, as here unionism is very strong. It is practically impossible for a man to get employment as fireman, coal passer, oiler, or engineer unless he belongs to the union. The wages, which are settled between the Lake Carriers' Association and the Longshoremen's Union, are higher than on the salt water, but the season is shorter, opening about the middle of April and closing generally about the middle of December. The engineers are taken on board, however, about the middle of March for fitting out the vessels.

From the answers received from several of the transportation companies of the Lakes, we make the following extracts:

No. 14. Cleveland and Buffalo Transit Company, Cleveland:

All the employees of our engineering department belong to the union, which, of course, necessitates our looking to the head of this organization in the different cities where we land. Wages are governed by the Lake Carriers' Association. F. F. Newman, Gen. Manager.

No. 15. Erie and Western Transportation Company, Buffalo:

We are always glad to get hold of capable and energetic young men, of course preferring men who have had some shop experience. They would have to start in as oilers, which position at present pays $52.50 per month. After serving an apprenticeship they are, as you know, examined by the U. S. Inspectors for second engineer. We try to pick out men having fairly good education, as well as men being in good physical condition. "Unionism" seems quite the thing on the Lakes at present, and it would undoubtedly be necessary for a young man seeking work of this nature to belong to the union. Application for a position of this sort should be made to the chief engineer of the line. The engineer's crew are put on board about the middle of March and the vessels are brought out a month later.

E. T. Evans, Western Manager.

No. 16. Goodrich Transportation Company, Chicago:

The policy of this company is to advance its employees, whenever possible, when the employee is worthy. There is no regular form of application, but the applicant should apply either to the superintendent or chief engineer of the line. Education and physical condition are taken into consideration, but previous training is more essential. This year we have paid coal passers $18 per month; firemen, $45; and oilers, $47.50. The labor conditions are such that we have had to accept any and all kinds of help, not being able to pick same. The men that are engaged in the occupation of firemen are not of a class that a young man of good habits would care to associate with, and for this reason it is hard to get men to take up the firing position. With the oilers it is somewhat different. Their living quarters are better than those of the firemen. At this season of the year we are cutting down rather than adding to our force. The time to apply to us would be along in the early spring.

H. W. Thorp, Gen'l Manager.

No. 17. Pittsburg Steamship Company, Cleveland, Ohio:

Men are hired by the chief engineers of the ships, unless in some cases the engineers write or telegraph the home office to send them a man. When they do this we endeavor to secure men who have had experience in the business. While education is a grand thing for young men entering the engineering department on ships, as well as in other business, at the same time it

is of very little use to them in their daily work. Even a first-class mechanic has no chance to practice his trade when acting as a fireman or oiler on lake steamers. They have their regular line of work to perform and are not asked to do anything else; in fact, are not permitted to do any of the fine work, such as adjusting or fitting parts, or anything of that kind. The proper way for a young man to get a position is to apply direct to the chief engineer of a ship. If he is industrious and intelligent his chances are excellent for rapid promotion. F. B. Smith, Asst. Chief Engineer.

No. 18. Lake Carriers' Association, Cleveland, O.:

Young men as a whole gravitate into the engine room as oilers, water tenders, or firemen, with machine-shop experience. The wages are at present $52.50 per month, though up to the 1st of September they had been $47.50. The usual method is to apply to a fleet manager, who would, if favorably disposed, refer the applicant to his chief engineer, and the chief engineer would in turn send him to the engineer on board the ship.

Geo. P. McKay, Treasurer.

MARINE ENGINEERS IN GOVERNMENT EMPLOY.

Among the thousands of Uncle Sam's employees, it is safe to say that every trade and profession known to civilized life are represented. As numerous vessels of all descriptions are necessary for all well-regulated governments having sea coasts, and navigable rivers, and other bodies of water, the profession of marine engineering is quite naturally called upon to furnish its quota of Government employees. To the uninitiated in such matters, a person holding any kind of Government position is looked upon as one enjoying more or less of a sinecure. He is also thought to be the possessor of considerable "pull," as political influence is rather tersely expressed. While these conditions existed to a certain extent not many years since, quite the opposite state of affairs is now extant. Especially is this so with those employed as marine engineers, where for obvious reasons political influence has but little weight in the selection of men to fill such important positions.

Of the several maritime services which form part of the Government, the navy naturally is the most important. With great battleships such as we now possess, having steam machinery costing in single cases over a million of dollars, the personnel must be carefully selected and well trained for the trying duties imposed upon it. The commissioned officers who perform engineering duty at sea are, of course, all graduates of Annapolis. As this sketch is to treat only of positions available to persons in civil life, no more need be said of the commissioned force, except that it is admittedly inadequate in numbers, and that undoubtedly before many more years there will have to be large reinforcements taken in from civil life. That phase of the situation will naturally interest those contemplating a life in the navy and who are unable to obtain a cadetship at the Naval Academy.

To enter the naval service in the engineering branch it is now necessary to begin at the bottom of the ladder and work up. As there is comparatively little chance for a man to gain advancement from coal passer through the grades of fireman and oiler, and become a machinist, as those who operate the machinery are termed, it is much better to learn the trade on shore and then to enlist as a "machinist." The following rules for such enlistment are published by the Navy Department:

1. A candidate for enlistment as a machinist must be a machinist by trade, must know the names and uses of the various parts of marine engines and boilers, and must be able to perform work with various tools in a machine shop, including bench work.

2. He must be able to write legibly, and must understand arithmetic.

3. He must be physically sound, and at the date of first enlistment must be not less than 24 nor more than 35 years of age.

4. Machinists who have had no experience at sea with marine engines will be enlisted as "machinists, second class," at $40 per month.

5. Machinists who have had experience at sea with marine engines for one year may be enlisted as "machinists, first class," at $55 per month.

6. No person will be enlisted as chief machinist unless he holds a permanent appointment as such.

7. The examination of candidates for enlistment as machinists, regarding their knowledge of engines and boilers, must be made in the engine rooms of ships; and regarding their knowledge of machine work, in the workshops of navy yards.

There are at all times vacancies for first-class men who possess the foregoing qualifications. Application for enlistment can be made at any navy yard or at any recruiting station. After entering the service as a second-class machinist, for instance, any man who is sober and attentive to his duties will find rapid advancement. There is a corps of warrant machinists, 150 in number, who are appointed from the enlisted machinists upon the basis of their records, and also as the result of competitive examinations. These positions are for life and are practically the equal, with the exception of pay, of commissions, as they are entitled to the benefits of retirement and of the pension list. The first three years after date of appointment they receive $1,200 per annum at sea and $900 on shore; the second three years, $1,300 at sea and $1,000 on shore; the third three years, $1,400 at sea and $1,300 on shore; the fourth three years, $1,600 at sea and $1,300 on shore; after twelve years from date of appointment, $1,800 at sea and $1,600 on shore.

With such salaries as these and the possibility that commissions and increased compensation may eventually be given to warrant machinists, the naval service presents an attractive field for ambitious young marine engineers.

Under the Treasury Department there are several branches which employ marine engineers, the most important of which is the Revenue Cutter Service.

There are at present four vacancies in the list of second assistant engineers of the U. S. Revenue Cutter Service. These offer exceptionally fine opportunities for bright young marine engineers to obtain a life position. The examinations for this service are strictly competitive and are open to any American citizen between the ages of 21 and 28 years who has had not less than six months' sea service and has served not less than eighteen months in a machine shop. No political influence is necessary, as permits to take the examina-

tion will be issued to any applicant who produces satisfactory certificates as to age, moral character, and sea or shop experience. Candidates must be sound physically, as a rigid examination is given each competitor by a board of Marine Hospital surgeons before the professional examination is begun.

The professional examination is wholly written and will be conducted by a board of engineer officers of the service. It will consist of questions on the English language, arithmetic, algebra, trigonometry, physics, elementary mechanics, heat, steam and expansion, the chemistry of combustion and corrosion, boiler design, practical questions on the care and management of marine engines and boilers, valve gears, proportions of screw propellers, electricity on shipboard, the use of the indicator, and interpretation of diagrams, etc. It is not at all necessary that candidates have a college education, as there have recently been several appointments made of bright young men who have obtained their education by their own efforts in studying standard text-books on the subjects named.

Since the recent enactment of a law giving U. S. Revenue Cutter officers the same pay as officers of equal rank in the army, these positions are very desirable from a financial standpoint. Immediately upon appointment a second assistant engineer receives $1,400 per annum. He is then in the line of promotion, and as a first assistant engineer will receive $1,500 per annum, and as a chief engineer his salary will be $1,800 a year. In addition to these basic salaries officers receive 10 per centum additional for each five years of service up to a total of twenty years' service, when this increase stops. A chief engineer who has been in the service for a period of twenty years would therefore receive $2,520. A first assistant engineer who has been in the service for, say, ten years would receive $1,800 a year. Under the old system prior to the passage of the new law the salaries were $1,200, $1,500, and $1,800, respectively, with no increase for length of service.

Further particulars as to the time and place of examination, method of application, etc., can be obtained by addressing a letter to the Hon. Secretary of the Treasury, Washington, D. C.

The Marine Hospital Service and the Coast Survey give employment each to a small number of marine engineers. Appointments are made through the civil service, and the qualifications necessary are such as are required for licenses from the Steamboat Inspection Service. The salaries paid vary from $50 to $125 per month, according to the grade of license and size of vessel.

Marine engineers are also employed on vessels of the Lighthouse Service. They are appointed through the civil service, except that the examinations are made by the Inspector in charge of each district. The examinations in this service are also the equivalent of those given by the Steamboat Inspection Service. The average pay for chief engineer is $90 to $100 per month, although on some of the larger vessels they receive $125 per month. Assistant engineers average $80 or $90 per month. Since the steam lightships have come into use, opportunities are offered on them for engineers. For licensed men who like to lead a quiet life and not do much cruising, these vessels offer exceptional opportunities. The chief engineer of a lightship receives $960 per year, and his assistant has $780 per year to spend (if he ever gets ashore). These vessels are a novelty in one feature at least; that is, that the chief engineer gets $60 a year more salary than the captain receives, which is a step in the right direction.

During the war in the Philippines a large number of licensed marine engineers found good positions on the vessels of the Army Transport Service. The number of vessels in this service is now greatly reduced, and the chances for employment likewise diminished. The wages paid are about the same as those in the merchant service, varying from third assistant at $65 per month up to chief engineer, some of whom receive as high as $200 per month.

An opportunity for employment on shore, to those marine engineers who are tired of going to sea, is offered, in a somewhat limited field, by positions in the corps of Assistant Boiler Inspectors in the Steamboat Inspection Service. These positions are quite lucrative and can be obtained by competitive examination before civil service examining boards. Some of the more important requirements are that the applicant must be a resident of the local inspection district in which the vacancy occurs; that he is physically able to crawl through a 9-inch by 15-inch manhole; that he has had three years' actual practical experience as chief engineer of ocean or inland steamers of over 100 gross tons, as first assistant engineer of inland steamers of 600 gross tons or over, or as first assistant engineer of ocean steamers of 1,500 gross tons or over; that he is between 25 and 55 years of age.

Those possessing the above qualifications are given a competitive examination in the following subjects:

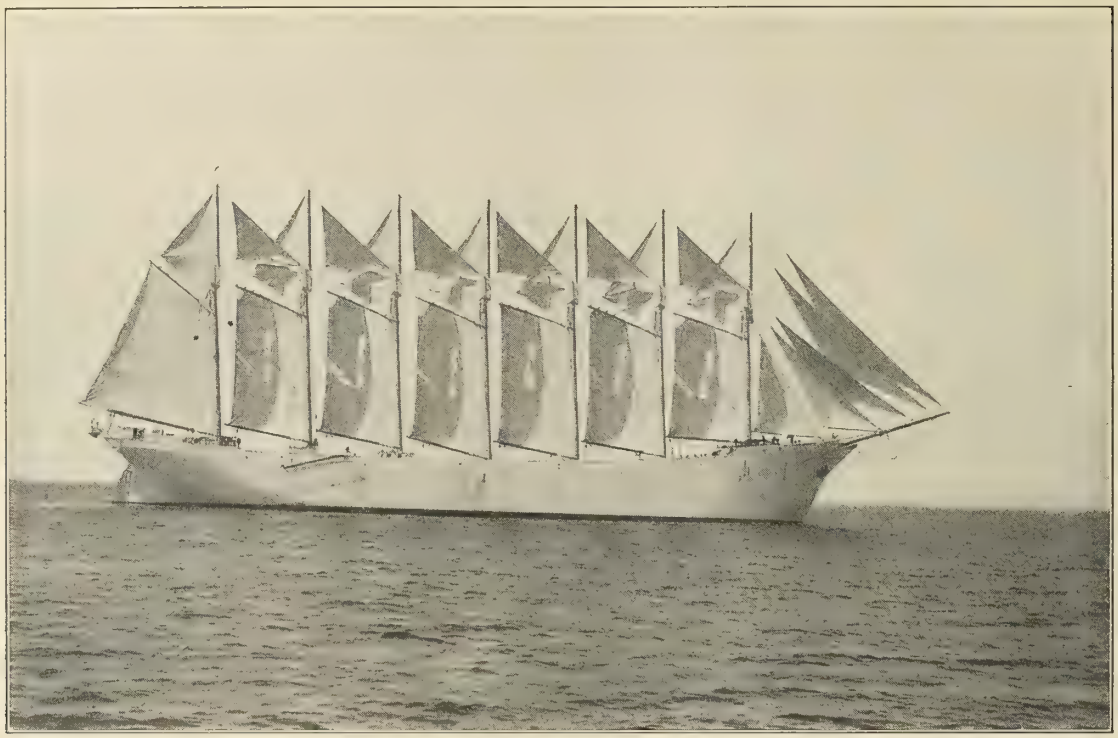
1. Letter writing.
2. Arithmetic (consisting of problems in common and decimal fractions, mensuration, and square root).
3. Boilers and machinery (comprising practical questions relating to boilers, engines, and machinery of steam vessels, and strength of boiler materials).
4. Experience (based on applicant's certificates, etc.).

The salaries at the beginning vary from $1,200 to $2,500 per year, and the positions are practically for life, depending, of course, upon good conduct.

Engineers who have been to sea are often in demand in what is known as the "Custodian Service," connected with the care of public buildings. The age limits are between 21 and 55 years, and the salaries paid vary between $720 and $1,080 per annum. The questions given applicants are such that any licensed marine engineer should be capable of answering, and apply to steam-heating and electric plants as well as to steam plants.

From the foregoing it will be seen that there are many opportunities for ambitious young marine engineers to gain permanent positions in the Government service. With but few exceptions, all the positions herein named are within the reach of those who have the ability to fill them.

Floating Machine Shop.—A naval constructor of the Boston Navy Yard has recommended that a floating machine shop be built for use in repairing ships. The shop is to be built on a scow which is to be thoroughly equipped with machines and tools for carrying on repairs.



THE THOMAS W. LAWSON UNDER FULL SAIL.

(Copyright, 1902, G. W. Davenport.)

MECHANICAL EQUIPMENT OF A SEVEN-MASTED SCHOONER.

The seven-masted schooner *Thomas W. Lawson* was put into commission and towed from the Fore River yard to her anchorage off South Boston on September 8, her glistening white hull looking as little as possible like that of a collier. She made her first trip to Philadelphia for coal under the command of Captain Arthur L. Crowley. The official measurements made after the schooner was afloat are as follows: Gross tonnage, 5,218; net, 4,914; length on water line, 368 feet; beam, 50 feet; and depth, 35 feet 3 inches.

The schooner has steel lower masts 135 feet long and pine topmasts 58 feet long, and the height of her topmast head is 155 feet from the deck. Her steel bowsprit is 85 feet long. The lower masts, which are 32 inches in diameter and which weigh, complete, nearly 20 tons each, were stepped before the schooner was launched. The masts were moved alongside on rollers, the yard locomotive hauling them to the slope of the beach. A very large pair of shears were erected on the deck, with falls connected with one of the schooner's own winches, and when the masts were hoisted they were kept away from the ship's side by means of steel guys. The aftermost mast, called by Captain Crowley a "pusher," was stepped first, and the shears, which stood at right angles to the fore-and-aft line of the schooner, were warped forward for each successive mast.

The machinery was also installed while the schooner was on the stocks. Steam power is furnished by two vertical boilers, 56 inches in diameter by 90 inches high, one in the forward house and one in the after house,

MANOEUVERING IN BOSTON HARBOR.

(Copyright, 1902, G. W. Davenport.

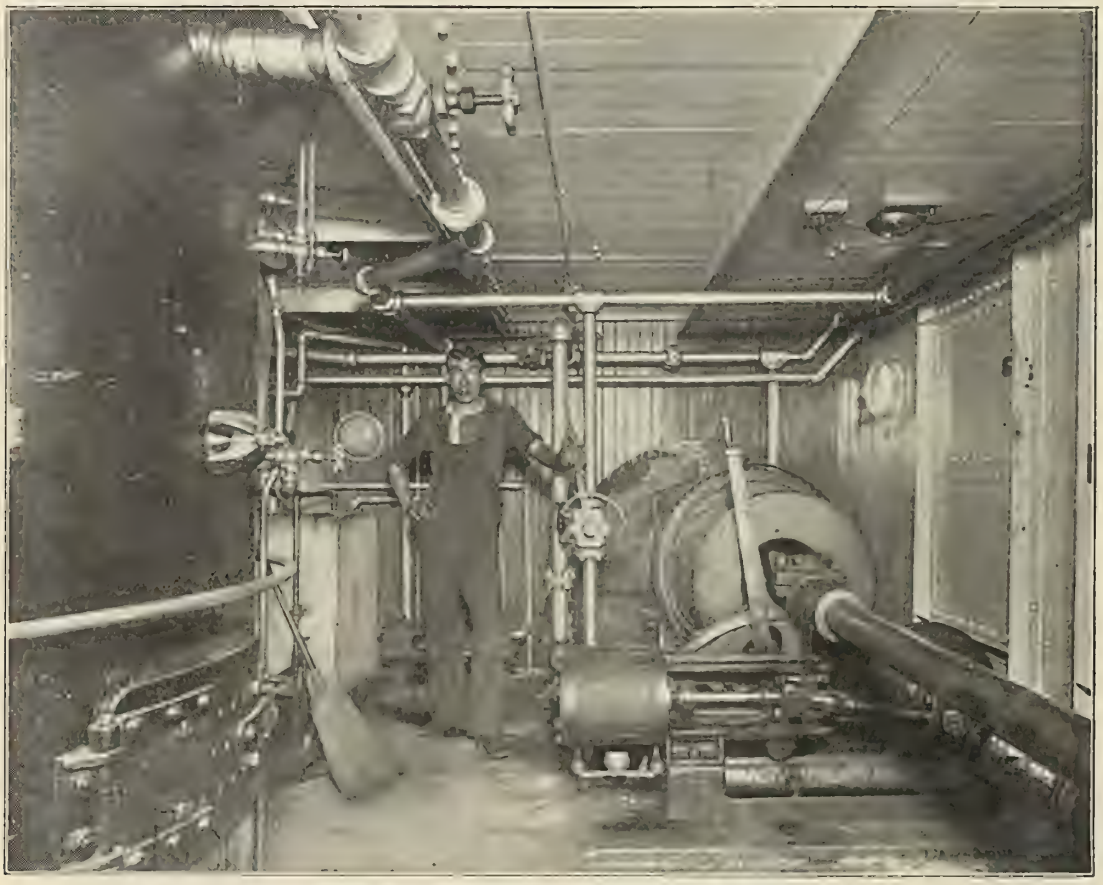
with inspirators, injectors, and all the concomitant fittings. There is one 9 by 10-inch double-cylinder ship engine for the forward house, with friction drum and winch heads on an extended drum shaft on the outer end. There are also five 8 by 8-inch hoisting engines, with link motion, on deck, with galvanized iron winch heads on each end of the drum shaft. Two coil condensers are employed to condense the exhaust steam for the hoisting engines, and each will feed a fresh-water tank of 300 gallons capacity. There are two direct-acting steam pumps for drainage purposes with steam and water cylinders, each 12 inches in diameter by 12 inches stroke. There is also a 6 by 4 by 6-inch duplex donkey pump of the packed-piston type, located near the after boiler, and one 7 1-2 by 5 by 7-inch pump of similar type located near the forward boiler, both piped for use as circulating pumps and also for washing decks and for fire purposes. Two hand pumps of the deep-chamber type are provided for emergencies. The windlass is of the Hyde pump-brake type with double-geared messenger attachment and iron bitts. Wildcats are fitted for a 2 3-4-inch chain. The windlass which is used for hoisting the 10,000-pound stockless anchors is under the forecastle deck, and the 40-horse-power engine which is connected with it by a messenger chain also operates a "nigger head" on deck. On the fore-

DECK VIEW ON THE SEVEN-MASTED SCHOONER THOMAS W. LAWSON, LOOKING FORWARD.

castle deck there is also an independent steam capstan to be used for warping or other purposes.

The machinery is so arranged that it can be operated by two engineers to do all the work required. The after engine, for example, which has 25 H.P., is enclosed in a deck house with the after boiler and steam pump, so that all can be under the command of one man.

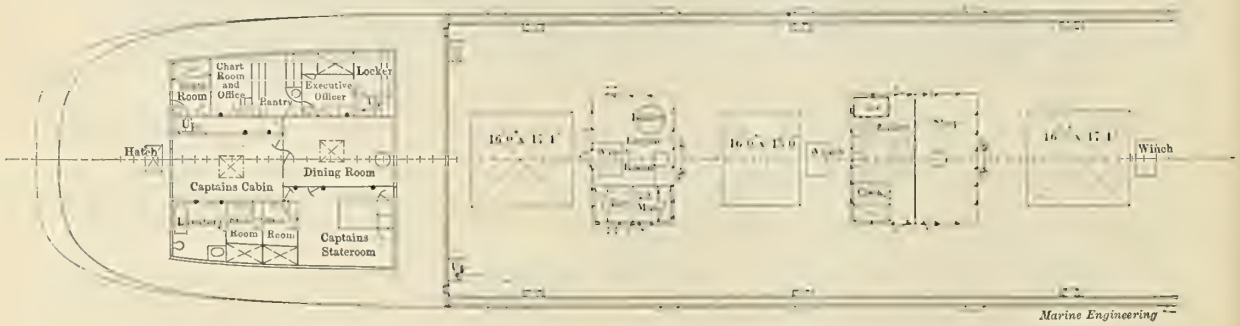
are trained through lead blocks in a line with the shrouds and then led through snatch blocks to the winch heads. The foremast has five 4 3-4-inch steel-wire shrouds, while there are four for each of the other masts. In addition to a double forestay there are two knighthead stays and two jibstays, each of 4 3-4-inch wire, with a total breaking strain of about 200 tons.



FORWARD ENGINE ROOM ON THE THOMAS W. LAWSON.

It is designed in hoisting and trimming sail that all the work should be done by the forward and after engines. The halyards from the three forward masts and for the forestaysail and jibs train to the forward winch, while the halyards from the four after masts train to the after winch. The peak and throat halyards, jib halyards, topsail halyards, topping lifts, and sheets

The *Lawson's* suit of sails comprises seven spencers, seven topsails, seven topmast staysails, a fore staysail, a jib, a flying jib, and a jib topsail. She has besides five storm trysails. The spencers, which weigh about three-quarters of a ton each, are hoisted by throat halyards with a fourfold block at the masthead and a triple-throat halyard becket. Each peak halyard has



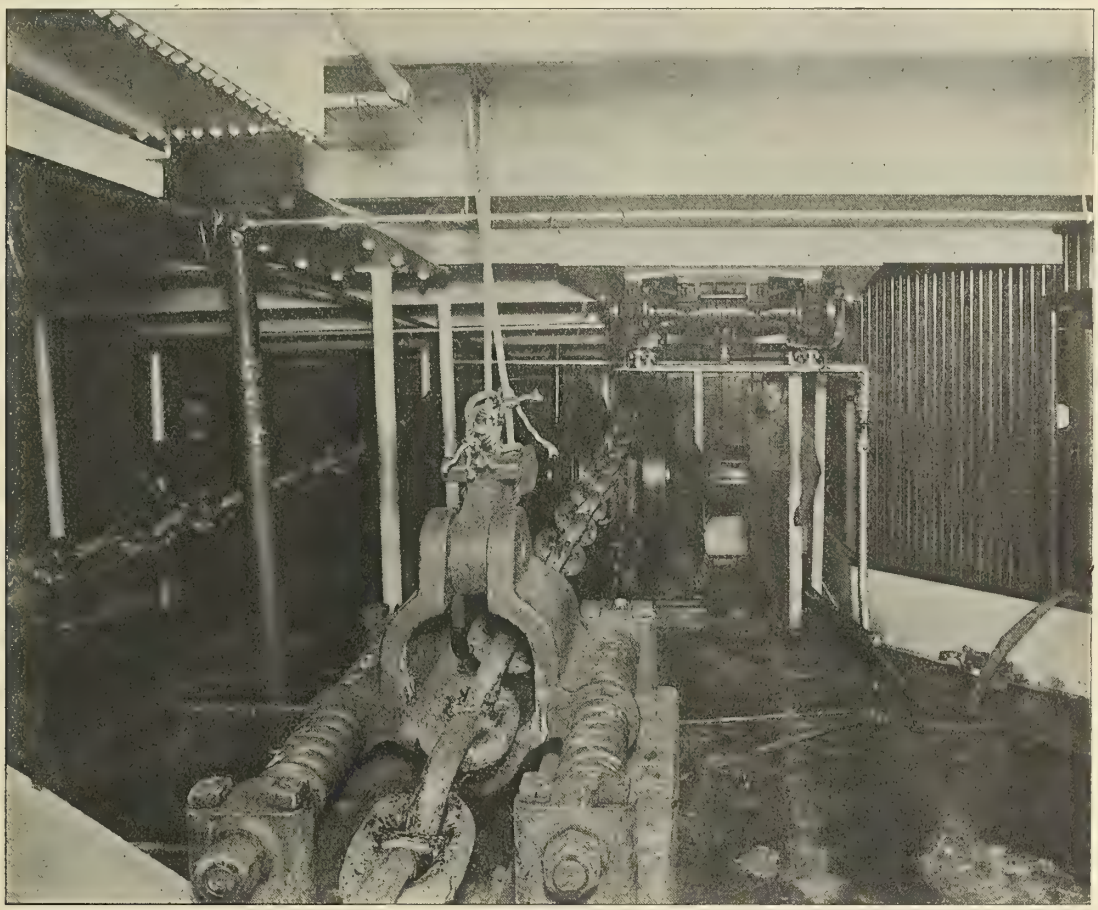
DECK PLAN OF THE SEVEN-MASTED SCHOONER THOMAS W. LAWSON,

one double and two single blocks at the masthead and four single blocks on the gaff. Two sails can be hoisted at the same time, the throat halyards being led to the port and the peak halyards to the starboard winch heads.

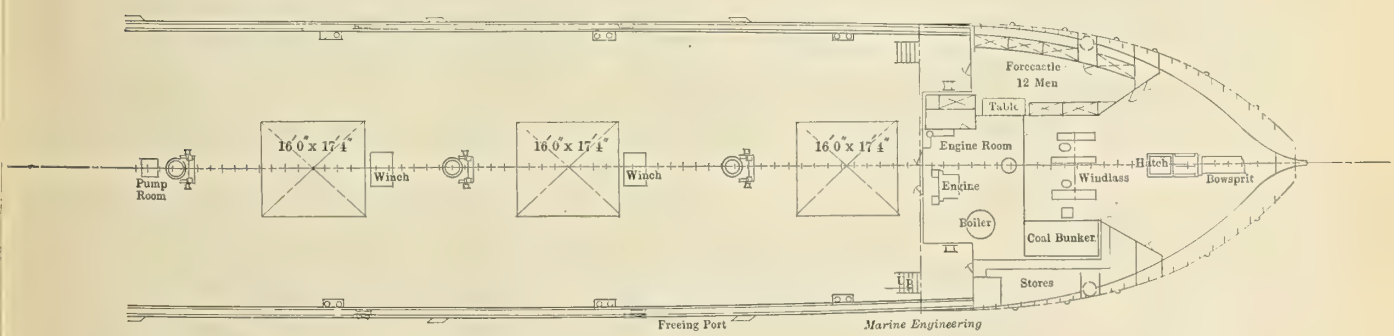
The four amidship hoisting engines of 25 horse power each will be used for hoisting or trimming the light sail after the schooner is under way and there is plenty of time for the engineers and men to go from mast to mast and handle one sail at a time. But the chief uses of the amidships engines will be for loading or unloading cargo. Each of the six engines is forward of a hatch, and forward of each engine is a mast to which a spar can be rigged for hoisting purposes. It is therefore possible, if enough men are employed, to handle cargo from all six of the hatches at the same time. The smokestacks from each of the boilers branch off laterally to port and starboard, so that by closing the windward opening the smoke will go to the leeward of the masts and sails.

The *Lawson* has four steam pumps, two of which, working together, will pump 6 tons of water a minute and can unload 1,000 tons of water ballast in about two and a half hours.

The steam-steering gear is of the Hyde pattern and is operated by means of a worm acting on a shaft which has a right-and-left screw thread, with one nut attached to the starboard end of the rudder crosshead and the other to the port end.



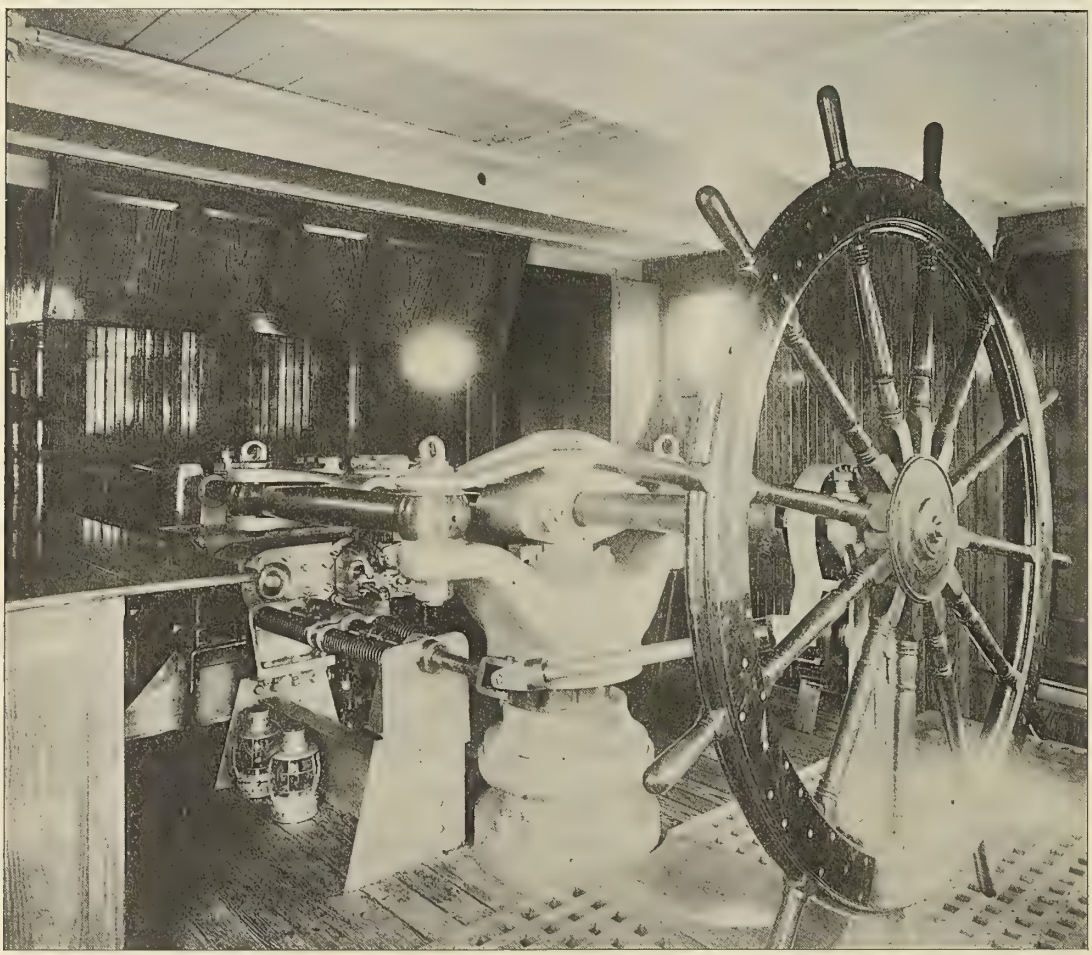
ANCHOR HOIST AND DEVIL'S CLAW IN FORECASTLE.



BUILT BY THE FORE RIVER SHIP AND ENGINE COMPANY.

The mechanical equipment of the schooner includes a telephone circuit connecting the wheel house with both the forward and after engine rooms, and an electric-lighting plant of sufficient capacity to light the whole ship with incandescent lights.

It is believed that the *Lawson* is the first of a type of vessels which will revolutionize ocean freight carrying. The five-masted schooner *John B. Prescott* and the six-master *George W. Wells* had already demonstrated the economy of large sailing vessels, and on the latter schooner steam had already been employed for handling sails and the number of men in the crew materially reduced. The *Lawson*, with her engines, will require the services of but 16 men all told, whereas a square rigger of the same size would need at least 35 men; and it is expected that the schooner's sails can be changed in about a third of the time that would be necessary for the same operation on a square rigger. The economy over steam-propelling power is thus very evident.



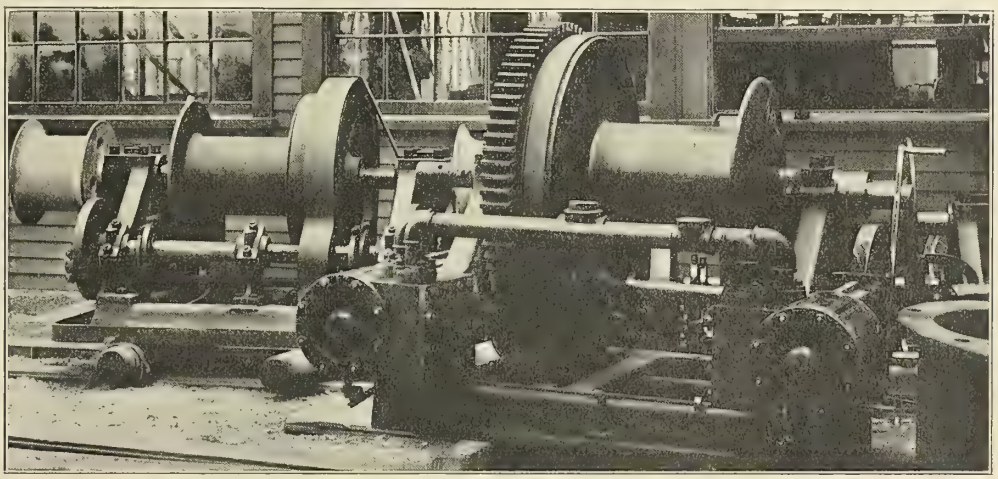
STEERING GEAR AND WHEEL HOUSE OF THOMAS W. LAWSON.

The limit of size for a wooden vessel seemed to Captain J. G. Crowley, the managing owner, to have been reached in the six-master, and consequently he awarded the contract for the seven-master to a steel shipyard, instead of to one of the wooden yards on the coast of Maine from which most of the big schooners have been launched. Not only would an excessive strain be put upon a vessel's hull by so many masts and such heavy rigging—the *Lawson* spreads 43,000 square feet of canvas—but the keelson which a wooden ship of anything like the same dimensions would require occupies so much space that might otherwise be given to cargo, and is in itself such a burden to carry, that a double economy would be accomplished by steel construction. The carrying room gained by the difference in the thickness of the hull is also an appreciable item.

The *Wells* is 335 feet long over all, with 48 feet beam; the over-all length of the *Lawson* is 403 feet 4 inches (the other dimensions are already stated), and when fully loaded she will draw 26 feet 6 inches. With this size she has a carrying capacity of 8,100 tons—nearly twice the capacity of the six-master, and three or four times that of many steam freighters. While these increased proportions give such greatly increased carrying capacity, the fixed charges—wharfage, pilotage, towage, and all manner of port expenses—are but little increased. Being a schooner, too, the *Lawson* has an advantage over any other type of sailing vessel in the cost of towage, for example; and her equipment of engines will enable her to do much of her own stevedore work, which will be no little economy, especially when she is in foreign waters.

In various other respects the use of steel and steam

will give the *Lawson* marked advantages. She has been built of steel in a very much shorter time, for instance, than she could possibly have been built of wood, her launching being set for just about eight months after the laying of the keel. Fully fitted out and classified as A 1 for 20 years, she will have cost $250,000, which is not much more than wooden construction would have cost, and what little difference there is in the initial expense will be soon made up, Captain Crowley feels assured, by the saving on repairs. She is to have a double bottom four feet deep, in which, if need be, a thousand tons of water ballast may be carried. The pump well gives free access to the double bottom, so that at any time a man may enter it for inspection. Lighthouses such as have never been put on a schooner before take the place of the old-fashioned lightboxes.



ONE OF THE STEAM WINCHES USED ON THE THOMAS W. LAWSON.

SUGGESTIONS AS TO THE PREVENTION OF CORROSION OF TAIL-END SHAFTS.—II.*

BY JOHN BODDY.

Adjourned Discussion.

The Chairman, Mr. Aisbitt, said the first point which struck him in considering Mr. Boddy's appliance was the simplicity with which the oil was applied, once it entered the stern tube, by the outside water pressure. They were told in the paper that when the engines were running full speed ahead, ten minutes after the oil was emptied into the top of the iron pipe, the sounding rod indicated the depth of 1 1-2 inches of liquid, the shaft being immersed about 2 feet; that, after the vessel was moored, after coming from Newport to Barry Dock, and the engines were at rest, the sounding rod indicated a depth of about 2 feet of liquid, this corresponding with the shaft's immersion. This, so far as he knew, was the first occasion which had proved a semi-vacuum in the stern tube, the vessel going full speed ahead. Mr. Boddy put in a pipe to reduce that vacuum, so that they were led to believe that there might have been a greater vacuum even than what Mr. Boddy found. Unfortunately, the paper did not say whether the vessel was loaded when going full speed ahead; but whether loaded or in light trim, he was inclined to think that the semi-vacuum would not be increased to any extent, that there would be practically the same centrifugal action in the way of the stern tube. Going ahead they got the same vacuum, and going astern they naturally forced the water inward. He recalled the recent case of a vessel which had been ashore four or five hours upon a pebbly beach. She was driven astern for about six hours, with the result that the vessel picked up pebbles, and the liner was cut down from about 1-2 to about 3-16 inch, thus showing the force of the propeller action was inward.

Mr. Henderson, while agreeing that lubrication was a very good thing, believed that the best method of preserving shafts was to fit a continuous liner with a very short tube and cover the shaft and the tube all over with one liner. In this way they got practically a parallel shaft. He was not in favor of running any shaft on a white metal bush. As to Mr. Boddy's appliance, he did not think it was a good one without an outer gland.

Mr. Roberts said Mr. Boddy was the first to take steps to ascertain what really had been going on in the tube. He thought Mr. Boddy's experiment of testing the depth of liquid on the shaft confirmed what the chairman had said about a partial vacuum taking place. In some experiments conducted some years ago to ascertain whether the propeller was effective or not, it was found that a partial vacuum was formed at a point in front of the propeller, apparently due to the screwing action of the propeller giving a tendency to draw the water away from the shaft through the effort of propulsion. This would account for the sudden drop in the tube which Mr. Boddy fitted, and also explained the oil getting down to the shaft. It would be naturally expected that when the oil was placed in the tube it would, by its specific gravity, float on to the water, but Mr. Boddy had discovered that the water left the tube and the oil followed its way downward. Mr. Boddy had proved that there was a certain body of dead water remaining in the tube, and this water revolving with the shaft attacked the zinc, and galvanic action was set up, which attacked the iron shaft near

*Paper read before Institute Marine Engineers.

the coupling. He did not agree that an outer gland was necessary. In the first place, he did not think it was possible to keep the gland perfectly tight, and when they stopped the engines and the supply of lubrication the hydrostatic pressure would force its way inward. Mr. Boddy's appliance was fitted to an existing shaft without any alteration of the stern tube. With the ordinary shaft running in lignum vitæ, his method to prevent corrosion was a good one and effective, unless it was intended to prevent the corrosion of the iron of the shaft and not the brasses, which was a secondary consideration compared with the longer life of a shaft. His own opinion was that the continuous liner was a good thing, but the difficulty was as to the length of the shaft. A long brass liner was very deceptive, and a jointed liner was not reliable. A short shaft was a solution of the trouble. This was being adopted on the northeast coast, with the result that they had been able to put in a shaft with one continuous liner, approximately 9 feet over all. This liner was run in a lignum vitæ bush; the lignum vitæ had not to be renewed so often, and a steadier shaft was got all through; and, of course, the corrosion question was eliminated. They had too long taken it for granted that there had been a separation of water there. Certainly oil would float to the surface, but it could not float if there was no water to float on.

Mr. George Walliker, on the question of vacuum, said some years ago he was in charge of some experiments for the late Mr. Parker, of Lloyd's, who was specially interested in the fitting of propeller blades. A small copper plate was fitted down the stern post to the body opposite ahead of the propeller, with a vacuum gage. It was a cargo boat trading between London and Hamburg, and on the trial run they got from 7 to 10 inches of water showing on the gage. So that there was certainly a vacuum at the stern tube end in front of the propeller.

Mr. Boddy, in reply, said, with reference to the observations of Mr. Simpson at the previous meeting, that the shaft alluded to in the paper had been running for six years and nine months, and the oil pipe arrangement was fitted about four and a half years ago. As to the advocacy by several members of an outer gland, in his opinion the oil pipe was sufficient, when fitted as near as possible to the after end of the stern tube, so that the outside water pressure might force the oil forward. The outer gland was not only unnecessary, but might be a source of danger where the lubricant had been neglected, when the shaft would be practically running without any lubrication whatever. His experience showed him that the oil was driven from the point at which it was put into the tube right through to the stern gland, where there was always a soapy run. With regard to the question of Mr. Johnson, the oil pipe was first fitted before the vessel was re-floated out of dry-dock, and about half a gallon of oil was poured down the pipe, since which he had found that half a pint used daily was sufficient. If the shaft was immersed when the oil was put down the pipe, the oil would go no further until some motion took place. With regard to the rubber ring fitted in the recess of the propeller, if it was fitted just sufficiently tight there was little fear of its forcing the propeller away. As to Mr. Watson's remark, oil certainly had a tendency to float outward and upward, but he failed to see how it was going either way against a pressure. Mr. Roberts could not reconcile the figures as to the depth of liquor. In his opinion the difference was attributable to the centrifugal motion of the shaft, combined with the scooping action of the propeller, forming the vacuum of which they had heard so much. As to the continuous liner, so long as the liner could be kept tight he did not suppose there would be much corrosion. As to the kind of oil used, it was the same as that used for lubricating the machinery, viz., Vickers'.

Mr. Robert Duncan described the good results that had followed the wrapping of shafts with marline and red lead, and said that years after this method had been applied he had found the shafts in excellent condition. The red lead seemed to protect the shafts much better than the rubber. They would see from Mr. Boddy's drawing that a cock was wanted at the bottom of the stern tube as well as on the top, and to get all the water out of the tube they must open the bottom cock and draw off the water until the oil began to come, when, presumably, they would have oil all round the shaft. But the fact that all that sand and grit was found in the stern tube showed that it was not so very tight.

Mr. B. T. Vickers (visitor) said he was very much obliged to the honorary secretary for sending him an invitation to attend this meeting, and he was very glad of the opportunity of being present, because the subject under discussion was one in which he took great interest. Mr. Boddy's experience appeared to be that putting oil into the stern tube had lengthened the life of the lignum vitæ in the stern bush. In the course of his business he (Mr. Vickers) had come into contact a good deal with steamers belonging to Continental owners; and so far as the steamers of Sweden, Norway, and Denmark were concerned, there were very few which were not running their tail shafts in oil, and a broken tail shaft was a thing practically unknown. The United Steamship Company of Copenhagen owned about 130 steamers, the whole of which ran their tail shafts in oil and they never had a break. Most of them were linerless shafts, running in cast-iron bushes, and the running of the shafts in oil was a great success. He instanced also the case of a large screw tug owned in the north of England, which was built in 1885, which had an iron shaft fitted with brass liners and running in a gunmetal bush, the shaft of which had been run in oil. About two years ago this boat was overhauled, when the shaft was found to be in perfect condition, the original tool marks being still visible on the part between the two liners. The wear on the brass liners was exceedingly slight, considering the fourteen years the shaft had been at work, only amounting to about 1-8 of an inch. New liners were fitted in the shaft, and it was replaced in the steamer and appeared likely to run for many years more; the splendid condition of the shaft being undoubtedly due to the fact that it had been run in oil from the commencement. After referring to several other points of practical interest in connection with the working of tail shafts, Mr. Vickers called attention to the importance of using in the stern tube only oil which was practically free from acid. He explained that some oils contained a considerable percentage of acid, and that an acid oil was liable to set

up galvanic corrosion in the same way as a solution of acid in water. He also pointed out that the action of sea water, which was a solution of chloride of sodium; upon the brass liner in contact with the shaft in the stern tube was exactly the same as that which took place in the battery of an electric bell with two different metals in contact in a solution of chloride of ammonia, and emphasized the importance of keeping the sea water entirely out of the stern tube. He said the best way to keep the sea water out of the stern tube was to keep the tube quite full of oil, this method having the further advantage that it effectually lubricated both the stern bush and the stern gland. The difficulty then arose of keeping the oil in the tube. Mr. Vickers exhibited a new patent stern tube gland which his firm had invented for this purpose.*

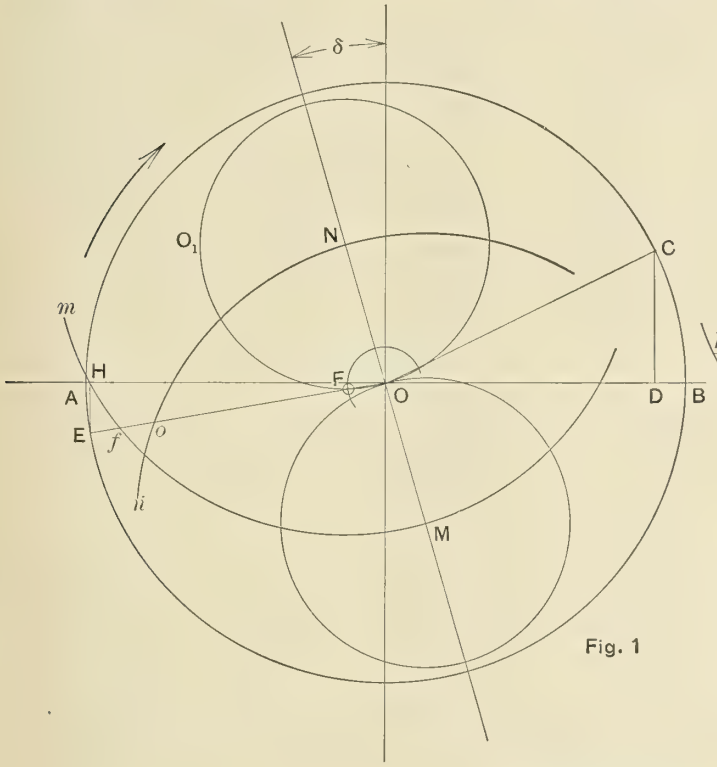


Fig. 1

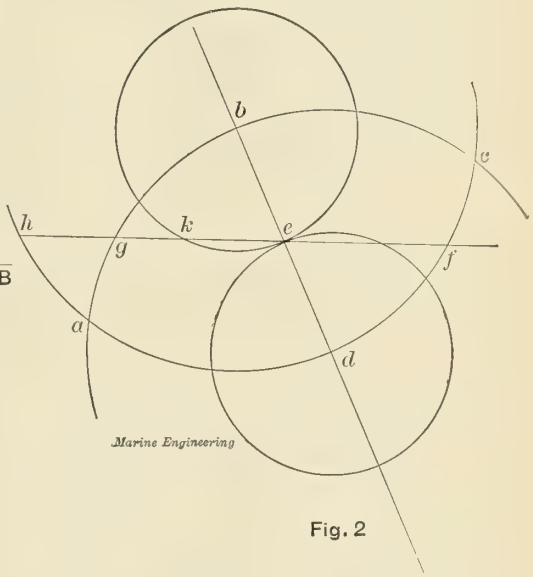


Fig. 2

THE ZEUNER DIAGRAM.

A Point in Connection with the Use of the Zeuner Valve Diagram.

BY N. AKIMOFF.

Zeuner's Diagram is one of the best known and is very often employed because it is both simple and very clear. And yet we know that many designers are not quite satisfied with it, as it is often impossible to take from it all the dimensions with a sufficient degree of accuracy. Therefore the diagram must be drawn in very large scale—for instance, three or four times larger than the full size. This is not necessary, for the accuracy depends entirely upon the manner in which the construction is made. The purpose of this note is to call attention to the very simple and useful method described by Professor M. Boulvin in his treatise on applied mechanics.

The diameter, *A B*, Fig. 1, represents the stroke, and the circumference, *A B*, the path of the crank pin. The size of this diameter is entirely immaterial for us. We can take *A B* = 6 1-4 inches or 100-16 inches. Then every 1-16 inch on the diameter is equal to one per cent. of the stroke. For instance, on this diagram we have the cut-off at 95 per cent. of the stroke. Now, if the angle of lap and the lead are very small the angle of intersection of the line *E O* with the circumference O_1 is extremely small, and it is almost impossible to take with accuracy the dimension *F O*, which is the steam lap. On the diagram, Fig. 1, the angle δ is 16 degrees, and the steam lead equals 1 per cent. What is the lap? May be 3-8 inch, may be 7-16 inch. Now, suppose we draw the circumference *n N* from the center *M*, and the circumference *m M* from the center *N*. Then *fo*—*i e.*, the portion of our line *E O* between these two circumferences *M m* and *N n*—is exactly equal to our lap *F O*, and we can take it directly and not pay any attention to the portion *F O*, which is difficult to measure. The reason for this may be seen by reference to Fig. 2, where *abcd* is a symmetrical figure and *e* is its center of symmetry. Then *ge* = *ef;* but *ef* = *hk*, because they are both symmetrical parts of the chord *hf*. Then *ge* = *hk*, or *ge* — *gk* = *hk* — *gk*, or *ek* = *gh*. We can therefore take our lap simply between these two circumferences with a high degree of exactness. In this case it is found equal to 11-32 inch.

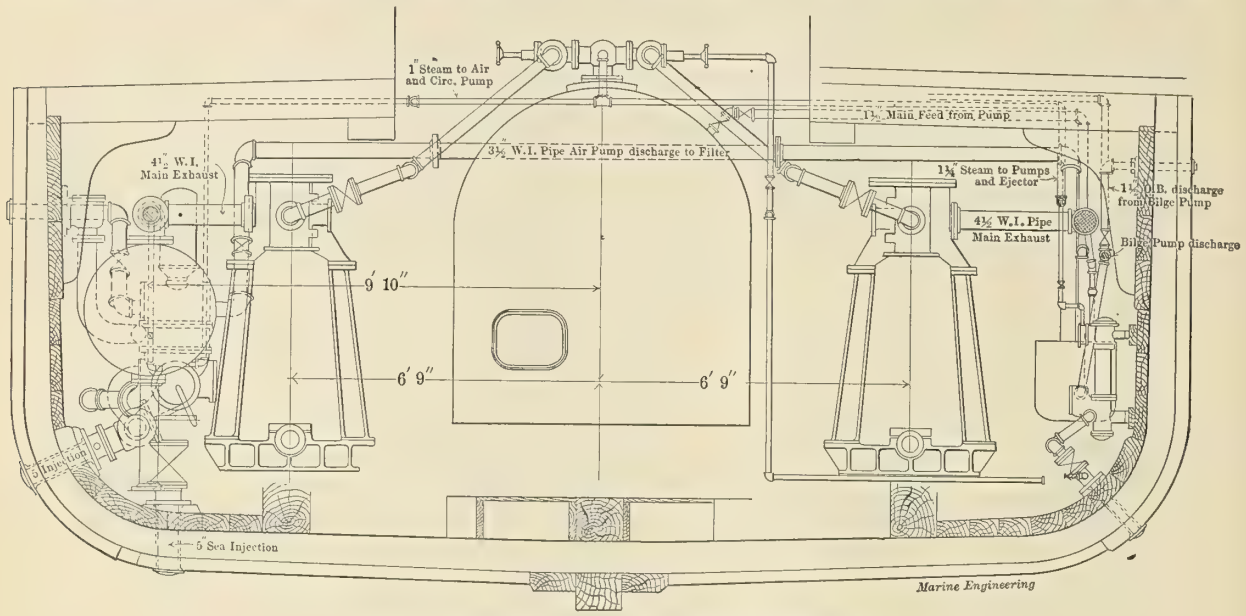
*For description see MARINE ENGINEERING for April, 1902.

New Service to Europe.—It is stated that a new service will soon be established from Boston to European ports by the New York, New Haven, and Hartford Railroad Company. The first line to be started will be to Antwerp, the vessels for which, it is understood, are to be furnished by the Ellerman Line.

NEW STEAMER FOR THE PHILIPPINES.

The first Boston-built boat for traffic with our new Oriental fields, the steamer *Concord,* recently sailed for Manila to engage in the lumber trade in the Philippine Islands. She was built by William McKee for the Boston and Iloilo Company, which is composed of Boston and Concord merchants. She is to be propelled by two compound engines in addition to sail power. The vessel is very strongly built, more so than is customary, and embodies some novel features of design. The frames are of live oak, 24 inches centers, 8 inches molded, and 6 inches sided, doubled, making 12 inches. The bottom planking is 3 inches, the side planking 4 inches, and the ceiling 5 inches. The spaces between frames are filled solid the whole length of the boat from the keel to the beginning of the bilges. She is coppered to the load water line and will carry a dead weight of 300 short tons. The *Concord* is fore-and-aft rigged, with no bowsprit, and the masts are heavy, being designed essentially for hoisting purposes. On the forward one is an 80-foot boom, and on the mainmast a 50-foot boom is arranged for handling the cargo.

The stack is 50 feet above the grate and so arranged


1" Steam to Air and Circ. Pump
1½" Main Feed from Pump
3½" W.I. Pipe Air Pump discharge to Filter
4½" W.I. Main Exhaust
1¼" Steam to Pumps and Ejector
1½" O.B. discharge from Bilge Pump
4½ W.I. Pipe Main Exhaust
Bilge Pump discharge
9′ 10″
6′ 9″
6′ 9″
Injection
5" Sea Injection
Marine Engineering

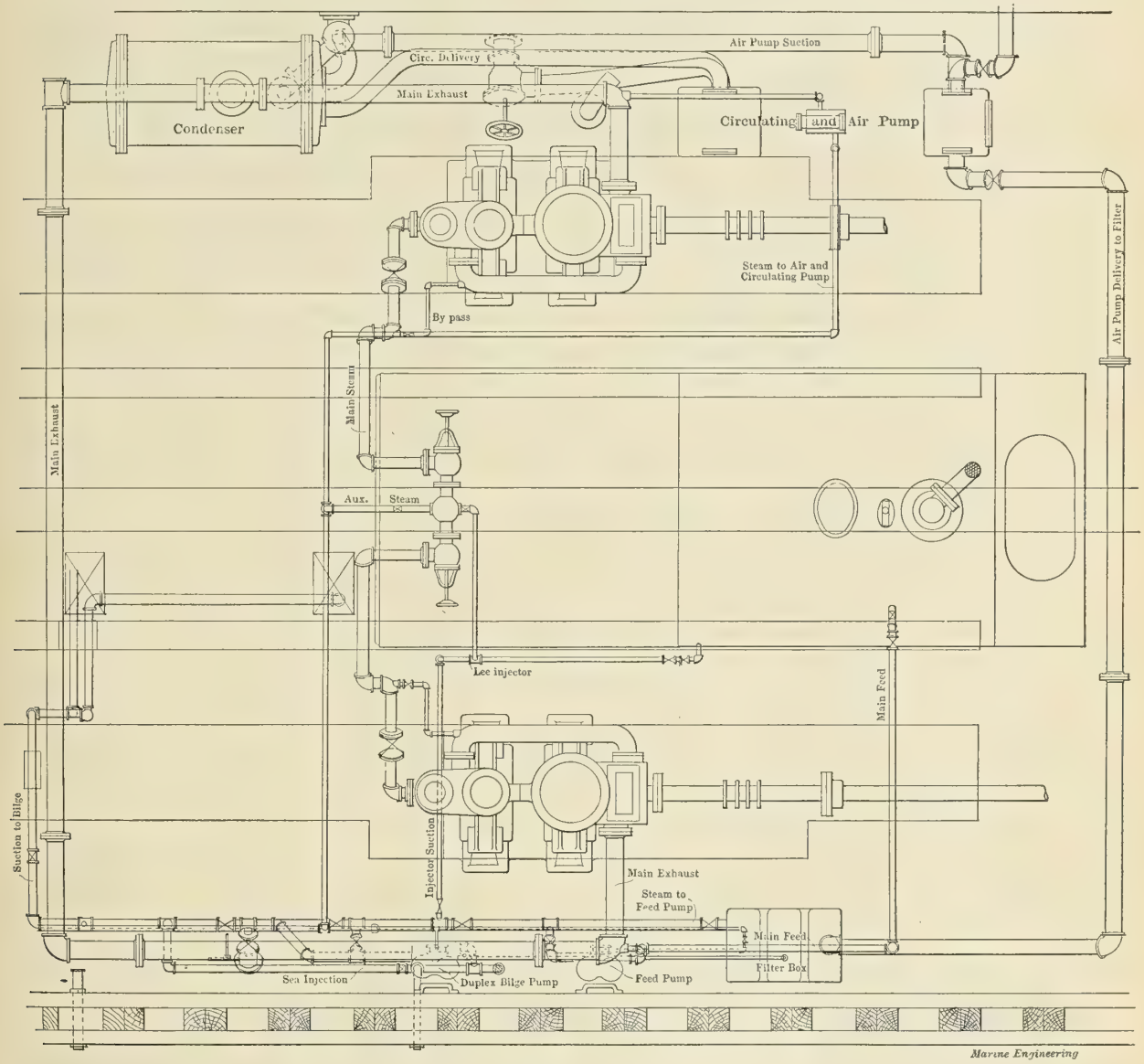
SECTION IN ENGINE AND BOILER ROOM, STEAMER CONCORD.

LIST OF PIPES.

Location.	Material.	Size.
Main steam	Wrought iron	2½ ins.
Auxiliary steam	" "	1½ "
Steam to injector	" "	1 in.
" " air and circulating pump	" "	1 "
" " feed pump	" "	½ "
" " bilge	" "	½ "
" " ejector	" "	1¼ ins.
" by-pass	" "	¾ in.
" for blowing out strainers	Wrought iron, with brass nipple in nozzle	½ "
" to whistle	Wrought iron	1¼ ins.
Main exhaust	" "	4½ "
Exhaust from air and circulating pump	" "	1¼ "
" " feed pump	" "	¾ in.
" " bilge pump	" "	¾ "
Suction air pump	" "	4 ins.
" circulating pump	Copper	5 ins. No. 13 B. W. G.
" feed pump	Galvanized iron	2 ins.
" bilge pump	" "	2 "
" from fresh-water tank	" "	2 "
" e ector to bilge	" "	2 "
" injector	" "	1 in.
" from filter	" "	2 ins.
Discharge from air pump to filter	Wrought "	3½ "
" " " " overboard	" " brass pipe through hull	3½ "
" " circulating pump to condenser	Copper	4 ins. No. 13 B. W. G.
" " condenser overboard	"	4 " No. 13 B. W. G.
" " feed pump	Brass	1½ ins.
" " bilge pump overboard	Galvanized wrought iron pipe. Brass through hull	1½ "
" " " " on deck	" iron	1½ "
" " ejector	Brass	2½ "
" " injector	"	1 in.
Pipe for wetting ashes	Galvanized iron	½ "
Whistle pipe	Wrought iron	1¼ ins.
Escape "	Copper	4 ins. No. 16 B. W. G.
By-pass pipe	Wrought iron	¾ in.

as to be easily taken down when the craft is under her own sails. The general dimensions are as follows: Length on keel, 122 feet; length over all, 130 feet; beam, molded, 25 feet; beam, over guards, 26 feet 4 inches; draft, loaded, 8 feet; depth of hold, 10 feet.

abreast of each other. As will be seen by referring to the accompanying pipe plans, the boiler is on the center line of the boat, and the twin-screw engines on either side, 6 feet 9 inches from the center. The boiler is of the locomotive type, 6 feet 6 inches in

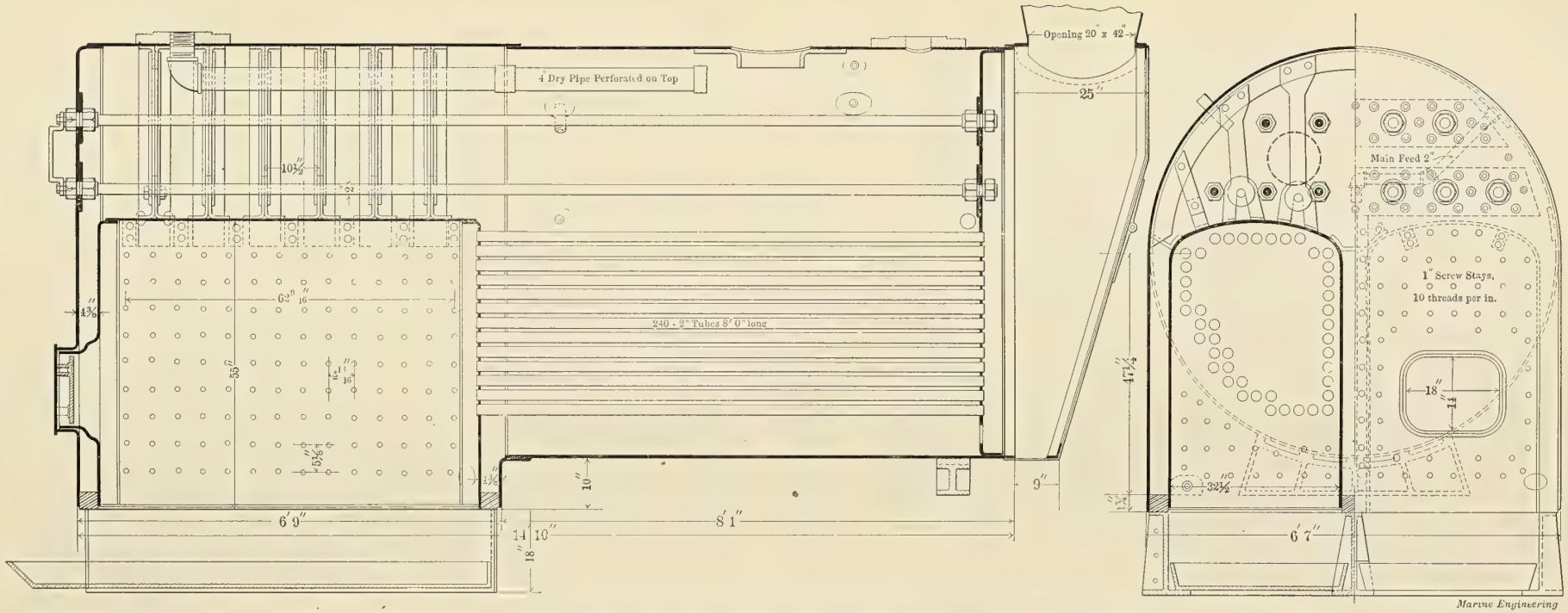


PIPE PLAN OF THE STEAMER CONCORD, ENGINED BY THE ATLANTIC WORKS.

	DRAWS FROM	DISCHARGES TO
Circulating pump.....	Sea	Through condenser overboard.
Air pump	Condenser.	To filter box and overboard.
Feed pump.....	Filter. tanks, and sea.	To boiler.
Bilge pump..	Bilge, tanks, and sea..	Overboard. on deck, and to tanks.
Inspirator.	Tanks, filter, and sea.	Boiler.
Ejector	Bilge	Overboard.

It is the arrangement of the machinery, however, which attracts especial attention. The boiler and engines were built by the Atlantic Works, of East Boston, and because of the vessel's large beam are placed

diameter by 14 feet 10 inches long. There are two separate furnaces, each leading into one hundred and twenty 2-inch tubes. The grate surface is 32 1-2 square feet, and the total heating surface is approximately



LOCOMOTIVE-TYPE BOILER FOR THE STEAMER CONCORD, FOR THE PHILIPPINE TRADE.

1,205 square feet, made up of 1,000 square feet in the tubes, 171 square feet in the furnaces, and 37 square feet in the smoke box. The ratio of total heating surface to grate surface is 38.6. The boiler is fired from the forward end. The engines are abreast of the boilers, as above stated, and the high-pressure cylinders, which are forward, are fitted with a piston valve. The arrangement of piping is of interest, as can be seen by following out the accompanying drawings. Steam is taken from a 4-inch dry pipe in the forward end of the boiler, and by T is carried to the two 2 1-2-inch main steam pipes, right and left. The exhaust from the two engines is carried to the condenser on the starboard side, where is also placed the circulating and air pump. The air pump delivers to the filter box on the port side, and nearby is the main boiler feed pump. Water in the filter box is heated from the pump exhaust. The principal dimensions of the machinery are:

Diameter cylinders	9, 18 in.
Stroke	12 in.
Condenser surface	328 sq. ft.
Revolutions	180
I.H.P.	175
Diameter propellers (bronze)	5 ft. 6 in.
Number of blades	4
Pitch	5 ft. 0 in.
Area of each propeller	10 sq. ft.

Petroleum in South Australia.—It is reported that oil of a good quality has been discovered in the southeastern district of Australia. At present oil is imported from Asia and America. In view of the immense coal fields of Australia, which have been recently estimated at 240 billion tons, that continent is well provided with fuel.

Trial of the Siberia.—The new steamship *Siberia,* built for the Pacific Mail Steamship Company, recently underwent a very successful sea trial, when she is reported to have made a maximum speed of 21 knots. The *Siberia,* with her sister ship the *Korea,* which were built at Newport News, were described in MARINE ENGINEERING of May, 1902.

STEAM TURBINES.*

BY HONORABLE C. A. PARSONS.

After referring to the trials of the *Viper* and *Cobra,* the two destroyers which were unfortunately wrecked, Mr. Parsons gave some interesting particulars on the early history of his invention. The compound turbine was first used in England in 1884 for driving dynamos. Three hundred and sixty plants of from 4 to 120 horse power, aggregating 5,000 horse power, were in use in 1890. Six years later 600 turbines of 40,000 horse power had been sold, the largest unit being of 600 horse power. At the present day there are 800 turbo plants in use, aggregating 200,000 horse power, the largest being 3,000 horse power. Two years ago Messrs. Brown, Boveri and Company, of Baden, Switzerland, took up the manufacture of compound turbines and sold 20 plants of 29,000 horse power, the largest of 5,000 horse power. The British Westinghouse Company has lately contracted with the Metropolitan and District railway companies for the supply of ten turbo alternators of 5,000 horse power, and several plants of moderate size have also been built by the Westinghouse Machine Company, of Pittsburg. The total aggregate of turbines at work and on order of the compound parallel-flow type, for generating electricity in England and on the Continent and elsewhere, was not far short of 300,000 horse power. Turning to the question of economic results, the author said that the lowest steam consumption so far recorded had been 17.3 pounds per kilowatt hour, with a 1,000-kilowatt continuous-current plant, one of several built for the Newcastle and District Electric Lighting Company. This figure corresponded to about 10.2 pounds of steam per indicated horse power hour. There seemed no doubt that still lower steam consumptions per horse power would be reached in turbines of large size working with superheated steam and a good vacuum. Several turbine plants had been tested after being at work for a considerable time, in order to ascertain if any increase of steam consumption occurred with age, and in all these cases no observable increase could be detected.

Reverting to the marine steam turbine, the paper stated that at present there have been seven vessels fitted—the *Turbinia,* the destroyers *Cobra, Viper,* and *Velox,* the Clyde passenger boats the *King Edward* and *Queen Alexandra,* and the yacht *Tarantula.* The large yacht *Lorena* will be completed this autumn. The destroyer *Eden* and the third-class cruiser *Amethyst* would be completed in 1903, and within the last few weeks orders for two turbine cross-channel boats of about 8,000 horse power had been placed with Messrs. W. Denny and Brothers. One of these vessels is for the Chatham and Dover Railway, for the Dover and Calais route. The total aggregate indicated horse power of the above-mentioned vessels was 82,900 horse power.

The question of coal consumption was next considered, and the author then described the method of economizing fuel at low speeds by the fitting of additional small engines. The excellent performance of the Clyde passenger steamer *King Edward* was next referred to by the author. These particulars also have already been given in these pages. Mr. Parsons quoted the remarks of Mr. James Denny at the launch of the *Queen Alexandra,* as to the results of experiments and trials made with the *King Edward.* If the *King Edward* had been fitted with balanced twin triple-expansion engines of the most improved type, and of such size as would consume all the steam the existing boiler could make, the best speed she could possibly have obtained would have been 19.7 knots, against the 20 1-2 knots actually done by the *King Edward,* showing an increase in speed of eight-tenths of a knot. This difference corresponded to a gain in indicated horse power in favor of the turbine steamer of 20 per cent. It would hardly have been possible to drive the *King Edward* at 20 1-2 knots with ordinary engines, owing to the extra weight of the machinery and the necessarily increased displacement. The attempt to do so could only have resulted in the speed being obtained at an enormously increased first cost and a ruinous expenditure of coal and the like on service. Referring to the question of coal consumption, the results of the *King Edward* on service had been compared with the *Duchess of Hamilton,* and from the comparison it had been found that the *Duchess of Hamilton,* at 16 1-2 knots, burned 16 tons, and the *King Edward,* at 18 1-2 knots, burned 18 tons. The *Duchess of Hamilton* had only compound engines; by the use of triple engines her consumption could be reduced; but even with triple engines, if she were to be driven at 18 1-2 knots on service, her consumption would have been over 22 tons, as against 18 in the *King Edward.* This corresponded to a saving of about 20 per cent. in favor of the latter vessel. The figures were based on the assumption that the *Duchess of Hamilton* was left as she was as regards displacement, but, as her speed was only 18 knots on trial, the greater displacement necessary to carry the extra weight of machinery for the higher speed would have resulted in a considerable increase in the coal consumption of 22 tons. The paper concluded by narrating the advantages that would follow the adoption of the steam turbine system of propulsion in vessels of large size, such as Atlantic liners, cruisers, and battleships. The benefit, the author stated, would be greater than in the case of smaller vessels, for the large turbines that would be suitable to such vessels would be cheaper to build, lighter in weight, and occupy less space in proportion to power. The design of such large turbines presented no difficulties beyond those that had already been successfully disposed of in the case of smaller vessels; and the greater size facilitated the introduction of important refinements for reducing coal consumption.

DISCUSSION.

Professor Unwin remarked that, as the larger the machinery the easier it became to operate, one could hardly conceive the limit of the steam turbine for purposes of ship propulsion.

Professor Dunkerley said that he had assisted in testing a steam turbine in 1897 and found it gave satisfactory results. By a comparison of the observed results of the *Turbinia,* there was a loss in efficiency of the whole mechanism of propulsion. The consumption of steam was 29 pounds per effective horse power per hour, and with a propulsive coefficient of two-thirds that would work out to 19 pounds per horse power. As Mr. Parsons attained a horse power on 15 pounds of

*Extract of paper and discussion read before the British Association for the Advancement of Science, held at Belfast.

steam, there was evidently a loss. From this it would seem that the *Turbinia* crossed at an efficiency of about 50 per cent., whereas the ordinary screw was 68 per cent.

Professor Hele-Shaw stated that Mr. Parsons had found the best way of using steam was by the parallel-flow turbine, which gave an increased economy of 15 per cent. These results were not reached, however, until the most extensive series of trials and experiments as but few people would have undertaken. He had seen details of a test made with the steam turbine against a Corliss engine at Elberfeld, where the turbine had shown considerably higher economy.

Mr. Parsons closed the discussion by stating he had superheated steam for running the turbine as high as 200 degrees, the pressure being 150 pounds to the square inch. He estimated the gain in efficiency due to superheating to be about 1 per cent. for every 10 degrees of superheat. The gain was rather higher for the first few degrees, but the figure stated was about the average. He had not gone very high yet; but he saw no reason why the steam should not be superheated up to any temperature within reason. It would, however, be necessary to keep the metal of the cylinder of uniform section, as any irregularity in the thickness would tend to bend the casting. He had been asked about high lifts for the reverse turbine. In New South Wales pumps were placed in series, and raised water a distance of about 700 feet, each pump working against a head of about 240 feet. The efficiency of screw propellers was a difficult subject. In the *Turbinia* he made an assumption that there was 55 per cent. between the indicated and propulsive horse power. That was on the basis that 14 1-2 pounds of saturated steam at 200 pounds pressure at the engine was used per indicated horse power per hour. If the augmented resistance due to the friction of the shafts, the under-water fittings connected with the propeller, the water on the blades, etc., were 10 per cent., that would bring the efficiency of the propellers to 65 per cent. That agreed with the tank experiments made by Messrs. Denny at Dumbarton, with a model from which the under-water fittings were removed. The slip rates of a screw would generally be about 22 per cent., but in the *Queen Alexandra* model it was 30 per cent. with flat blades. It should be noted that the velocity of the blade tips with the screw of the *Queen Alexandra* was not greater than that attained with the screws of third-class cruisers. The reversal of the marine turbine was effected, as stated, by separate blades, which ran in vacuum when not in work. It could be arranged that the blades would work in either direction by the reversal of the flow of steam, but this would mean that the form of blade would not be efficient for either direction of rotation. It was, therefore, best to shape the blades so that they would give the best results for going ahead, and have a separate set for the sternward motion of the ship. In regard to efficiency it might be added that the turbine had been tried against a Sulzer engine of the same power. At three-quarters load the two were equal; above that, the turbine had the advantage; but below, the reciprocating engine was best. The turbine, however, used from 1 to 2 per cent. less oil than the other engine, which would be about 16 per cent. on the value of the steam. At Newcastle station the use of steam turbines gave a saving which averaged 5 pounds a week in value.

Methodical Stoking for Large Installation of Water-Tube Boilers.

BY DAGNINO ATTILIO.

All who have had charge of the trials of a large warship fitted with water-tube boilers (or, indeed, with any type, although the difficulty is perhaps more accentuated with those of the water-tube type) will have experienced the great trouble there is in obtaining regular firing and a uniform charging of the furnaces, so that the evaporation may be of the same degree of intensity in the different furnaces, and that this intensity may be varied in precisely the proportion required to obtain the power to be developed by the engine. It is very clear that if it is left to the judgment of the leading stoker as to the quantity of fuel to be introduced into the furnaces under his charge, he in turn leaving it pretty much to the stokers themselves, they will naturally work by momentary indications of the pressure gages on the boilers in that compartment and at that particular instant, thus causing considerable fluctuation of the steam pressure from one period to another. Again, the stokers in one compartment, under an active leader, will fire up vigorously their boilers, giving the full amount of steam they are capable of, while in another compartment, under a less active leader, the stokers, seeing that the pressure is maintained, will content themselves with putting on just enough coal to keep up appearances, and the boilers in such compartment will consequently render but a small proportion of work, compared with the others. Among other bad consequences of unequal firing, perhaps the most serious is that, if the two compartments worked at such different rates of combustion are served by the same funnel, the boilers with grates partly uncovered will take most of the draft; for the air, naturally taking the line of least resistance, finds its way more easily through the grates with a small amount of coal on them, or partly uncovered. On the other hand, the draft is less in the boilers that are being vigorously fired and have the grates well covered, so that in the latter the combustion takes place under unfavorable conditions.

These troubles are well known to all engineers who are called on to carry out trials of large steamers, and are naturally more prominent in those navies of the world which are dependent on conscription for their stokers, thus involving continual change and little preparation before they are sent on board as able-bodied firemen. These troubles have also of late been intensified by the introduction of water-tube boilers. To obtain good results with boilers of this type it is very necessary to keep the grate surface completely but lightly covered with fuel, and this is altogether impossible save with regular and uniform firing. The first thing to be done, therefore, to insure the necessary regularity in firing is to calculate the quantity of fuel to be put in each furnace per unit of time, and then to decide what interval of time between the periods of firing is best adapted to the conditions in hand. It is then only necessary to work out a scheme for insuring the regular charging of the furnaces with the amount decided on at the intervals selected.

For each different intensity of evaporation there will, of course, be a different interval of time, and the most

convenient way of carrying out the change from one rate of evaporation to another is to draw up a table showing the different rates of firing corresponding to the indicated horse power required or to the number of revolutions to be made by the engines. These rates of firing may then be divided into a certain set of grades, so that when a given power or speed is required it is only necessary for the chief engineer to give the order for a certain grade, and the watchkeeper finds readily in the table what the charge should consist of and at what interval it should be fired.

rake, will appreciate how difficult it is to bring them to an understanding of what is required of them under the changed conditions found in water-tube boilers. It is perhaps even more difficult to induce the leading men accustomed to the old method of firing to realize the absolute necessity of implicit obedience upon the instructions given them. In the case of the *Garibaldi*, after the tables were made out it depended upon the leading men to give the signal at the commencement of each period. It was found, however, almost impossible to induce them to be sufficiently particular in work-

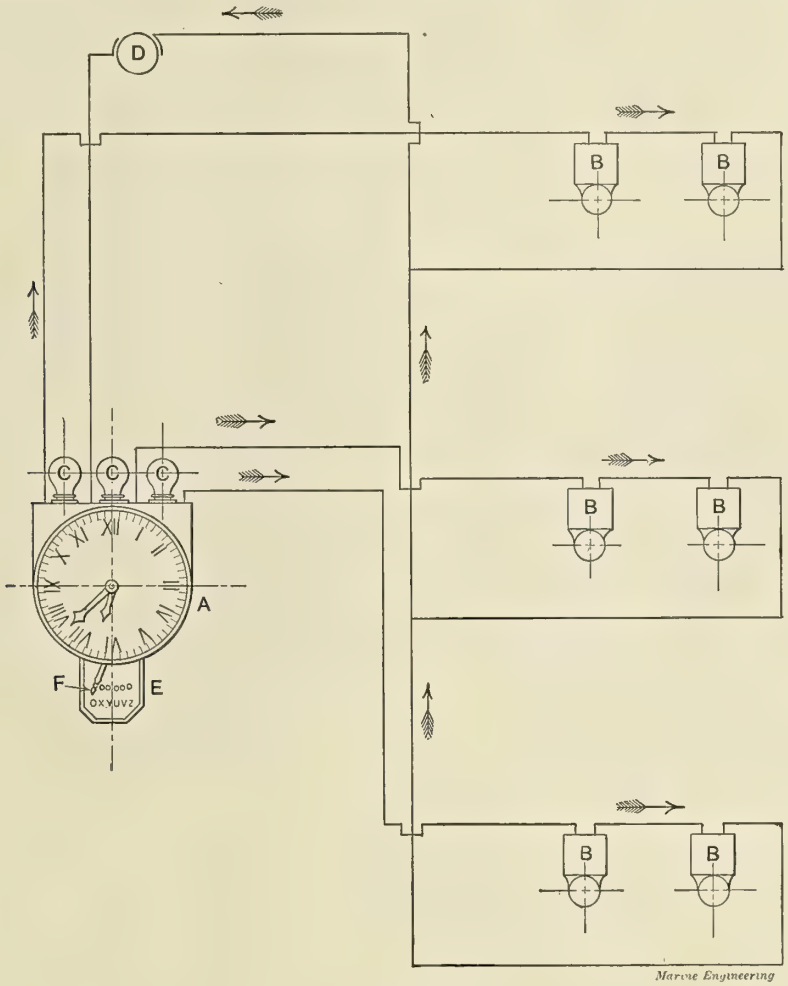


FIG. 1.

On the trials of the first vessel of the *Garibaldi* type fitted with water-tube boilers, as soon as it was seen that regular and equal firing was necessary to a proper development of the power, a clock with a second hand was fitted in each compartment of the stokeholes, and tables as mentioned above were prepared for the use of the leading men, each of whom was furnished with a whistle with which to signal the moment when the firing of the furnaces under his charge should commence.

All who have had to do with training for water-tube boilers stokers previously accustomed to piling up the coal in the front of a cylindrical furnace, letting it burn partly through and then pushing it back with a

ing to the desired periods of firing, and it soon became evident that it would be of great advantage if the human and doubtful element could be eliminated and the signals given automatically.

On these trials, the stokeholes were in charge of Cav. L. Perroni, the manager of Messrs. Ansaldo's steel works near Sampierdarena, and, realizing the need, he designed an apparatus for this purpose. This proved itself so satisfactory that those who have had experience recognize it as an actual necessity wherever water-tube boilers are fitted on board ship, as well as a valuable auxiliary if fitted with cylindrical boilers. The arrangement is shown in Fig. 1. *A* is a clock fitted in the engine room, and which replaces the clocks fitted

in the different stokeholes, and in connection with which is the regulating apparatus, which may be considered as analogous to the chief engineer giving his orders as to the periods for the different rates of firing. *B B* are electric bells fitted in each of the stokeholes (in this case six) to give the signals to commence firing.

On the top of the clock in the engine room is a series of glow lamps, *C C C*, in connection with the different circuits, and which light up while the current is passing, thus showing in the engine room if the circuits are in good order and the apparatus doing its duty. The current is preferably derived from the circuit for electric lighting, or, if this is not always charged, a series of cells can be provided, as at *D*. The different grades are marked on an index plate, *E*, under the clock, *F* being the regulating handle, with a pin to hold it in any desired position. As many grades may be arranged for as may be considered necessary, but in practical use it is

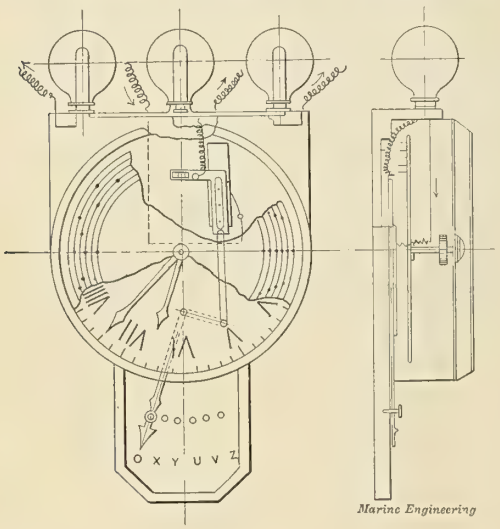


FIG. 2.

found that, as a rule, five will be found sufficient besides the position *O*. When the handle is placed at this the current no longer passes, and as the bells cease to ring all firing in the stokeholes is suspended. When the signaler is at work, the bells ring at the end of each desired interval of 20 seconds. The clock axle that carries the minute hand carries also a quadrant, which moves with the axle. On this quadrant and on circular and concentric zones are fitted small pins.

We may suppose a circular zone on which are fixed five pins. The quadrant, following the movement of the minute hand, will in one hour make one revolution of 360 degrees, and consequently in one hour the pins pass successively on the above-said plane at the regular interval of 12 minutes—that is, each pin will pass a given point every 12 minutes. If, then, a suitable contact piece is fitted, the passing of the pin will determine the closure of the circuit, and the signal will follow. We have supposed the contact piece fitted at the point where the circumference has five pins; but if, by means of a rod, this piece is moved to another zone with a different number of pins, then the interval between the signals will correspond to the number of pins in this zone, and in this way any desired arrangement may be made.

One great advantage of the apparatus is found in the fact that it leaves the leading man absolutely free to devote his full attention to his other duties. In modern cruisers, also with water-tight bulkheads carried up above the level of the water line, and no doors for communication between the engine and boiler rooms, it is necessary to transmit orders by voice-pipes to the stokeholes, of which there may be as many as twelve or more in a 20,000 horse-power vessel, so that it is no easy matter to communicate the frequent changes of speed to the boiler rooms when cruising in company. With the proposed method of communication, however, every possibility of error or misunderstanding is at once removed, and the signals are made with regularity and certainty.

With this method, the chief engineer has the rate of firing entirely under his control in the engine room, and when orders from the bridge are given to alter the speed of the engines, he has only to shift the key slightly to the new "grade" required, and without loss of time or possibility of error the rate of firing adapts itself to the new rate of speed. The stokers, too, find it an advantage, and after a little experience with it their shovels go almost automatically to the coal as soon as the bell is heard to give its warning, and they find firing regularly and equally much less fatiguing than in the old haphazard way. In practice it is also found to reduce the anxieties of water-tending; for, with absolutely regular firing with equal charges, the water level is maintained at an even height throughout, without any trouble whatever, even with hand regulation; and, indeed, it is found seldom necessary to touch the feed-regulating valve at all so long as the same rate of firing is maintained. An apparatus as above described was constructed and fitted on board the Italian *Garibaldi* (No. 4) and the Turkish *Messoudyèh* in time for the official trials, and was found admirably to fulfill the purpose for which it had been designed. Its use overcame all the difficulties that had formerly manifested themselves in obtaining regular and equal firing, with the result that the trials were very successful. It was afterward retained on board for regular use, and the engineers have reported that it was simply invaluable and also conducive to economy of fuel.

American Shipbuilding Company.—At the recent annual meeting of the American Shipbuilding Company the official statement showed its affairs to be in a most prosperous condition. The surplus earnings for the year ending June 30 were $1,184,257.52—this after paying 7 per cent. dividend on the preferred stock of $553,000, in addition to charging $420,293.55 for depreciation, putting aside $200,000 for improvements at Detroit and other places, and reserving $150,000 for the payment of a purchase mortgage on the Buffalo plant, thus freeing all property interests from mortgages or other encumbrances. The surplus for 1901 was $1,173,676.67, and for 1900 it was $568,665.85. The vessels built during last year numbered forty-one, with a carrying capacity of 198,500 net tons. The vessels now under construction number thirty, with a carrying capacity of 139,000 tons.

ETCHED SECTIONS OF STEEL FROM A BROKEN CRANK PIN.

The microscopical examination of steel and other metals with a view to the study of their mechanical properties as indicated by their crystalline and microscopic structure has in recent years acquired an increasing importance. For years the fact had been recognized that different samples of steel, for example, having the same chemical composition, and on chemical analysis rated as practically identical, might show surprising differences in physical and mechanical properties. It was clearly seen, in consequence, that some means of analysis beyond the chemist's balance must be developed if such differences were to be explained and their causes brought under intelligent control. The most effective and hopeful of such means has been the application of the microscope to the study of the structure of steel and other metals, as shown by the application of suitable etching agents. The appearances thus produced

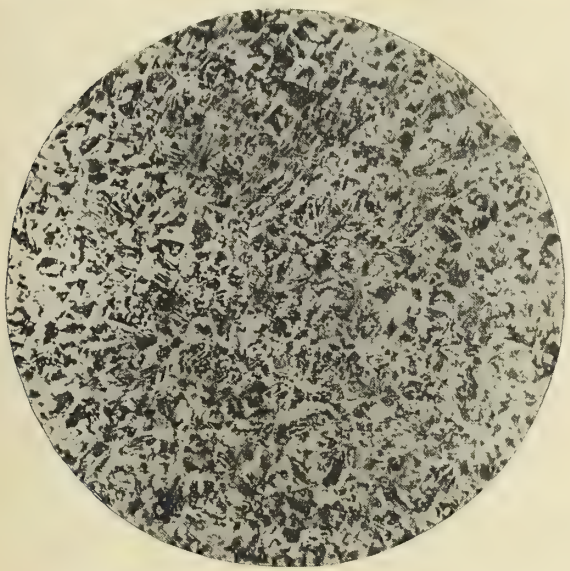


FIG. 1.

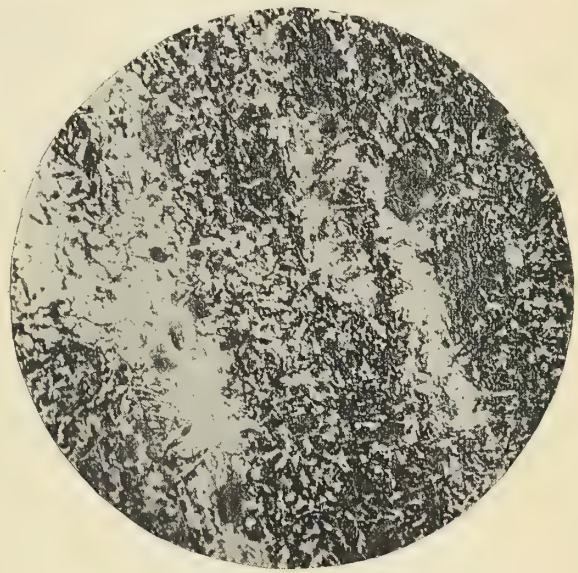


FIG. 2.

have sometimes been referred to as indicating "molecular" structure. This, however, is quite erroneous. Molecular structure is quite beyond the reach of microscopic or any other direct means of examination, and whatever is thus revealed, it is not molecular structure. The means thus available are, however, capable of showing the general characteristics of the crystalline structure, such as the nature, size, and arrangement of the crystals, as well as the general proportion of the metal which may appear to be truly crystalline and that which appears amorphous or non-crystalline. The general distribution of constituents having different properties is also indicated, and a series of varying indications may be more or less clearly made out, many of which may be by experience associated with the characteristic qualities of the metal itself.

The usual manner of developing the internal structure of a sample of steel, for example, is to first prepare a smooth polished surface, which is then subjected to the action of very dilute hydrochloric acid, tincture of iodine, or other etching agent. This agent acts differently on the various constituents of the steel, and in consequence will tend to show up the structure much as the structure of a macadam road is shown up by the action of a heavy rain or stream of flowing water. When sufficiently etched in this manner the surface is submitted to examination by the microscope under a magnification of 50 to 100 diameters or more. By this means the various features above noted may be more or less clearly made out. The relation between the appearance of these etchings and the mechanical properties of the metal is not, however, always clear, and careful study is required in the comparison of such etchings with the observed qualities of the metal before we can pronounce with confidence on the significance of the results obtained.

For purposes of record such etchings may be drawn or photographed, and the recent literature of the subject contains many excellent illustrations of such drawings or photographs, clearly indicating, even to the uninitiated, the excessively complex character of the important engineering metals.

In Figs. 1, 2, 3, and 4 are shown reproductions from photographs made from etchings on steel taken from a fractured crank pin of the steamer formerly known as the *Paris* and now the *Philadelphia*.

Fig. 1 shows a longitudinal section taken at the surface of the shaft and indicates what is considered to be the normal structure of a mild steel.

Fig. 2 is also a longitudinal section taken about four inches below the surface of the shaft, and indicates by the alternate light and dark bands a structure usually considered dangerous in a steel of this character.

Fig. 3 shows a transverse section from the same location as Fig. 2, and indicates by the suggestion of a lattice- or trellis-work pattern a structure usually considered as undesirable or dangerous.

Fig. 4 shows another transverse section from about the same location, but with a somewhat different type of structure.

Our knowledge of the relation between etchings of

metals and properties producing a metal structure liable to sudden fracture under vibratory stress, is far from complete, but, according to Professor Arnold, one of the leading workers in this field, the following appearances indicate dangerous steels:

1. Loose intercrystalline ferrite joints.
2. A trellis-work section in which the bars are ferrite.
3. Cellular structure of any kind.
4. A structure running parallel to the axis of a shaft and consisting of alternate bright and dark bands, due to alternate arrangements of areas of ferrite (white in the figure) and pearlite (dark in figure).

Fig. 2 shows the alternate bands, and Fig. 3 gives a suggestion of a trellis or lattice arrangement as referred to above.

As already noted, these etchings were made from steel taken from a crank pin of the former *Paris*. This crank pin failed in service, due possibly to a poor fit between the pin and crank webs, which allowed the webs to spread, thus giving rise to a periodic stress, which, acting on a favorable structure, as indicated in Figs. 2 and 3, gave rise to the development of fine cracks, which ultimately led to the failure of the pin. It should be noted that fine longitudinal hair-line surface cracks were to be seen on the pin near its junction with the web. This was the only outward evidence that the structure of the pin had undergone serious deterioration. This pin was made of simple carbon steel, and so far as known gave no evidence when new of any peculiarity of structure.

The views shown in the figures are all magnified 65 diameters, and the etchings were prepared in the scientific laboratory of the Bethlehem Steel Company.

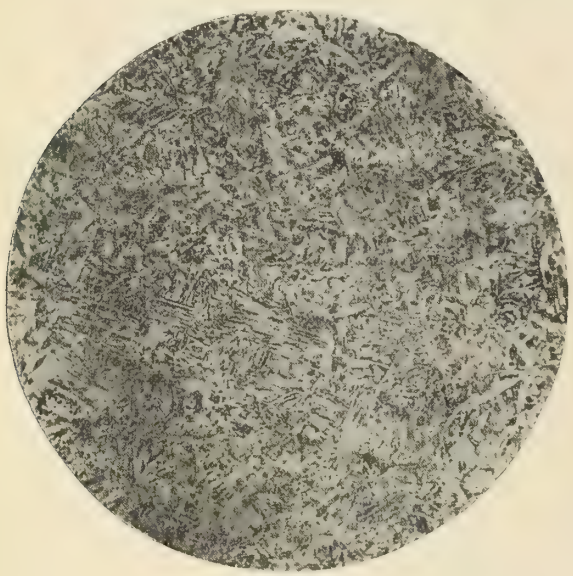


FIG. 3.

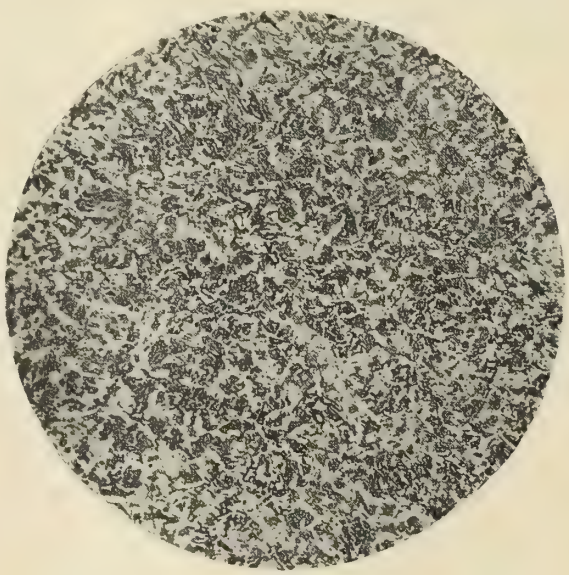


FIG. 4.

New Crafts for British Navy.—The British Admiralty has ordered nine additional torpedo-boat destroyers from private firms. It is stated the speed will be but 25.5 knots and that one of the vessels will be equipped with turbine engines.

MARINE ENGINES ON THE GREAT LAKES FROM A COAST ENGINEER'S POINT OF VIEW.

BY L. D. LOVEKIN.

It having been my pleasure recently to visit the office and works of the American Shipbuilding Company, at Cleveland, O., I thought it a good opportunity to make a comparison of the design as well as the finish of this class of engineering work compared with that of our first-class yards on the Coast.

The first impression that one gets on entering into an investigation of this kind is the very plain appearance of all these engines. If the visit be on shipboard, naturally the top of the engine shows up first, and owing to the cylinder heads and valve chests being painted all over, they naturally present a very plain appearance, especially to one accustomed to the bright work usually employed on the Coast, the latter of which to my mind adds materially to the selling price of a ship equipped with such machinery. This, however, is a practice which has been followed for years, and, with the small force usually available for keeping such work clean on these vessels, seems a necessity. The next point one observes is the use of cast iron grating throughout, and of wrought iron black pipe being used for stanchions and hand rails, with the exception of the top gallery, which is at times made of brass. Owing to the shallow draft of these steamers, there is a comparatively small amount of either flooring or railing used, and this is quite an important item as regards the cost of machinery. The next point we observe is the very plain oiling device used. The main bearings are only provided with a wrought iron pipe extending to the front of the engine, on which a dope cup is attached, such a thing being almost unknown to the engineer of the Coast. The water service, owing to fresh water being used, is of iron instead of brass, as is used for salt water. This also reduces the cost considerably.

The most recent engine design of the Great Lakes deserves considerable credit. In place of using six main

bearings, only four are used. While they are somewhat similar to the engines designed by Mr. John Hyde some years ago, they differ in the arrangement of valve gears. The engine is made very short, and in order to accommodate the valve gear, if of Stephenson type, a rocker shaft is provided so as to bring the M. P. valve gear immediately adjoining that of the L. P. gear, while the H. P. cylinder valve gear is forward. It is evident that the reduction of from six to four bearings also forms a basis for quite a saving throughout. I might add that these bearings are all bored out in place, and thus require very little scraping. The housings are of a very simple design. The reverse shaft, as well as the valve gear bearings, are all cast on the housings and have shaft set in place, and then babbitt is poured around, thus avoiding the machining of these entirely. The connecting rods of the recently designed engines deserve creditable comment, being of the single ended type and of the simplest possible design, almost all the work being done on a lathe. The lower end has a cast steel box of very light design, the box and lower end being in one piece. The upper end has a single brass box slipped into a recess in the connecting rod and made so as to be readily adjusted by means of an inclined block. Taken as a whole, the rod is very creditable both as to design and cost. The crosshead is also a very neat and simple design, being of cast steel finished all over with brass gibs for adjustment on both sides and ends. The piston rod is held in crosshead by a cotter, and the crosshead pin is held in the ordinary manner by means of taper, shoulder, and thin nut on outside.

The crank shafts are usually made with cast steel slabs and look very plain, but answer all purposes. Not even a fillet is provided on the crank pin. So it will be seen that the aim throughout is in the direction of reduced cost. I might also add that in many cases there is only a pinch wheel provided for turning the engines over in port, while we provide a turning engine, which again adds considerable to the cost. The main bearing caps are cast iron, single bolted, but with double bearing on the two inner legs.

The eccentric rods in many cases have cast steel ends for the forks. This I do not care for personally, although the ones I saw looked very well indeed, and in fact several Coast firms are using these ends. The links are very close together, and this greatly reduces the width of fork on rods. This is accomplished by means of using a large brass circular link block and the links passing through same. The design is such as to machine easily, but it makes a very large link-block pin. I might add that in some cases they have made eccentric rods without any yoke whatever, simply a straight rod fitting between the links. This, of necessity, requires more valve travel than ordinarily used, so as to give the required travel of valve at its working point, which puts the eccentric rod off the center of the valve at all times. I might add, while dealing with valve gear, that the piston valves have no false liners in chests. This again reduces the cost considerably, and is not necessary for the proper working of the valve when no small steam rings are used. This, however, has been done by several Coast firms also. They use slide valves for all L. P. valves and build the cylinder without any top cover (simply an outside cover). This avoids the troublesome joint and makes a very simple valve-chest cover. The reversing arms are elliptical in form and very simple. The wrought steel block that carries suspension link is also very plain. Most of the cylinders are of single bottom type. The crosshead guide is of slipper type one side only and of necessity cheaper than the double guide we fit on some engines. They also open up the casting of the housing on the front end and simple rib it. The false guide with water circulation when bolted to housing forms good construction for strengthening. We then notice that there is no expensive surface condenser and no circulating pump required, as the water to the jet condenser is supplied by gravity, and the cost of the jet condenser and air pump is small compared with a surface condenser similar to our practice.

The next important point relates to the shafting. They provide a cast iron tube and make one long outer bearing only of lignum vitæ in brass sleeve. This sleeve is usually made in halves, divided longitudinally as well as being in two lengths, held together by small dovetail pieces, the idea being to be able to renew the bearing without taking propeller wheel off or the shaft out, as they allow enough room from the bulkhead to the coupling forward to enable them to pull the shaft aft with the wheel in place a distance equal to at least one-half the total length of this bushing.

They can then pull bushing out, refill, and then place in position again. This would not be possible in the case of single screw steamers having a rudder post, for in such cases we only allow sufficient room to take off cap and draw shaft inboard and drop propeller off. I might add that in some cases there is no forward bearing in stern tube whatever, and more particularly that there is no brass sleeve on shafts, the steel shaft simply working on lignum vitæ bearing. This, as is well known, is a large item of expense saved, but could not be applied by us without considerable difficulty. In many cases where necessary to repair propeller shaft, it is necessary to remove thrust bearing complete. This could be avoided by using a special coupling or some other device, it being necessary then to remove only the thrust shoes and draw shaft inboard through thrust bearing. The auxiliary engines in most cases have connecting rods cast steel channel or "I" section, which makes this class of work very inexpensive.

In conclusion I would say that the one great aim seems to have been in the direction of reduced cost in every particular. Many of the above points, we must admit, would not be possible with builders of sea-going vessels. In fact, where the American Shipbuilding Company have had occasion to build sea-going vessels, such as they have recently turned out, they have found quite a difference in the cost of the two classes of work. The above article is intended to cover the work done on an average freighter and is by no means intended to cover the field that might be called special work, such as yacht and passenger work and vessels built for the revenue service, where expense is not a consideration. The latter class of work receives their very best attention.

THE ELECTRIC AUTOMATIC WHISTLE OPERATOR AND TELEGRAPH.

BY GEORGE MCQUILKIN, JR., E. E.

This apparatus is designed as an adjunct to the ordinary hand pull for opening the valve in the whistle pipe. Its functions are to place the whistle under absolute control, so that a blast can be repeated automatically at regular intervals or at the will of the operator. The flexibility of electric wiring admits of an unlimited number of operating points, which would be too complex if a mechanical means were used. From the fact that the valve responds instantly to the touch on the switch, by using a telegraph key signals may be sent by the Morse or other codes, and if the blast is not audible,

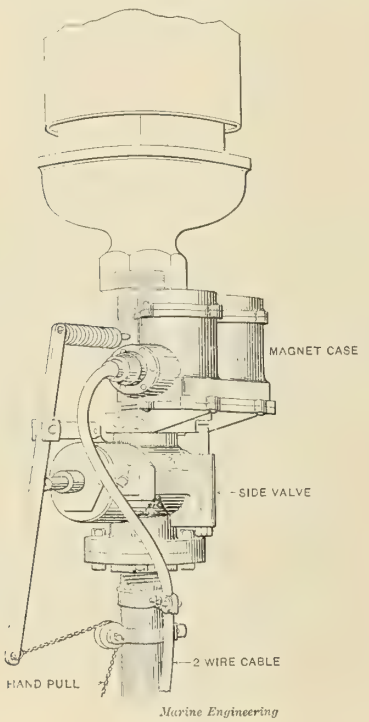


FIG. 1.

yet visible, the code may be read by the intervals between the escape of the steam.

The apparatus consists essentially of an electro-magnet carrying an armature which is normally held away from the pole pieces by a spring, but when it is desired to operate the whistle the switch is closed and the magnets are energized, attracting the armature, which in turn opens the valve in the whistle steam pipe, admitting steam to the whistle. The whistle valve and its magnet are located close to the whistle (Fig. 1), and the operating switch is generally located on the rail of the bridge.

The whistle valve is of special construction to admit of the use of the operating magnet, and is also fitted with the ordinary hand pull. This operates the main whistle valve (Fig. 4), as in ordinary construction. This main valve is normally kept closed by boiler pressure, but has a piston fitted, and when the switch is closed and the armature attracted by the magnets the stem opens the side valve and admits steam to the piston of the main valve, which is forced open and held open as long as the switch is closed and the armature keeps the side valve open. When the switch is opened the armature is returned to its normal position by springs, and the steam pressure from the boilers closes the side valve and then the main valve.

The automatic operator is generally located in the chart house, but, with a suitable water-tight case, can

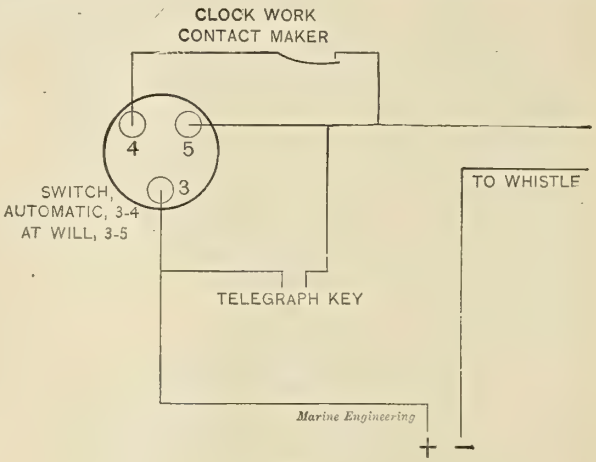


FIG. 2.

be located in exposed places. It is intended for use in navigating during stormy weather, the navigation laws requiring that a blast be sounded for six seconds duration at intervals of one minute. It consists essentially of a clockwork mechanism, carrying a contact maker that closes the circuit for the required length of

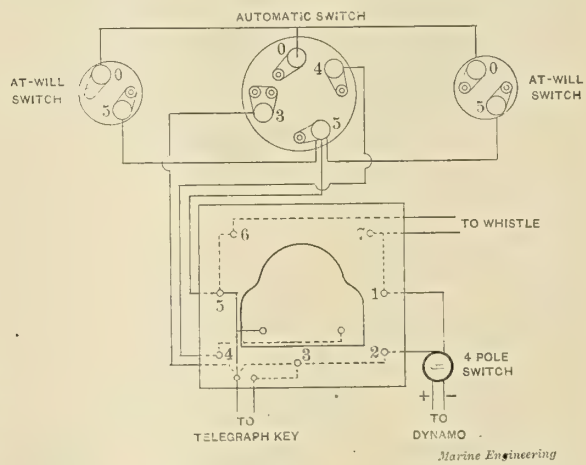


FIG. 3.

time. When it is required to operate, the switch is turned until the handle is held to the extreme left by the stop. This switches the clockwork contact maker into the circuit and operates the whistle automatically. The telegraph key is connected to the same wires that the switch is connected with, and this key being designed for rapidly making and breaking the circuit, its speed in signaling makes it superior to the switch for this purpose.

The elementary diagram of wiring is shown in Fig. 2. Starting at the positive side, it leads to the switch, and

for the "at will" operation it is closed across 3 to 5, thence to the whistle magnet, thence to the negative side. The telegraph key uses the same circuit as the "at will" operation, but does not pass through the switch. In Fig. 3 are shown the connections for two "at will" switches and one combined "at will" and automatic switch. The various binding posts on the automatic operator case are terminals for the various circuits and afford a ready means of separating the circuits for the purpose of testing.

are carried in the open it is advisable to use cable, using a twin conductor to the whistle and a triple conductor to the switch. In protected positions single wires, protected by wooden molding, may be used.

This apparatus is made for use with either battery or dynamo current, and if batteries are used they should be in groups of two or more sets, so as to avoid any liability of "running down" due to constant use. When operated by dynamo current a fuse of not over three amperes capacity should be installed in the main line.

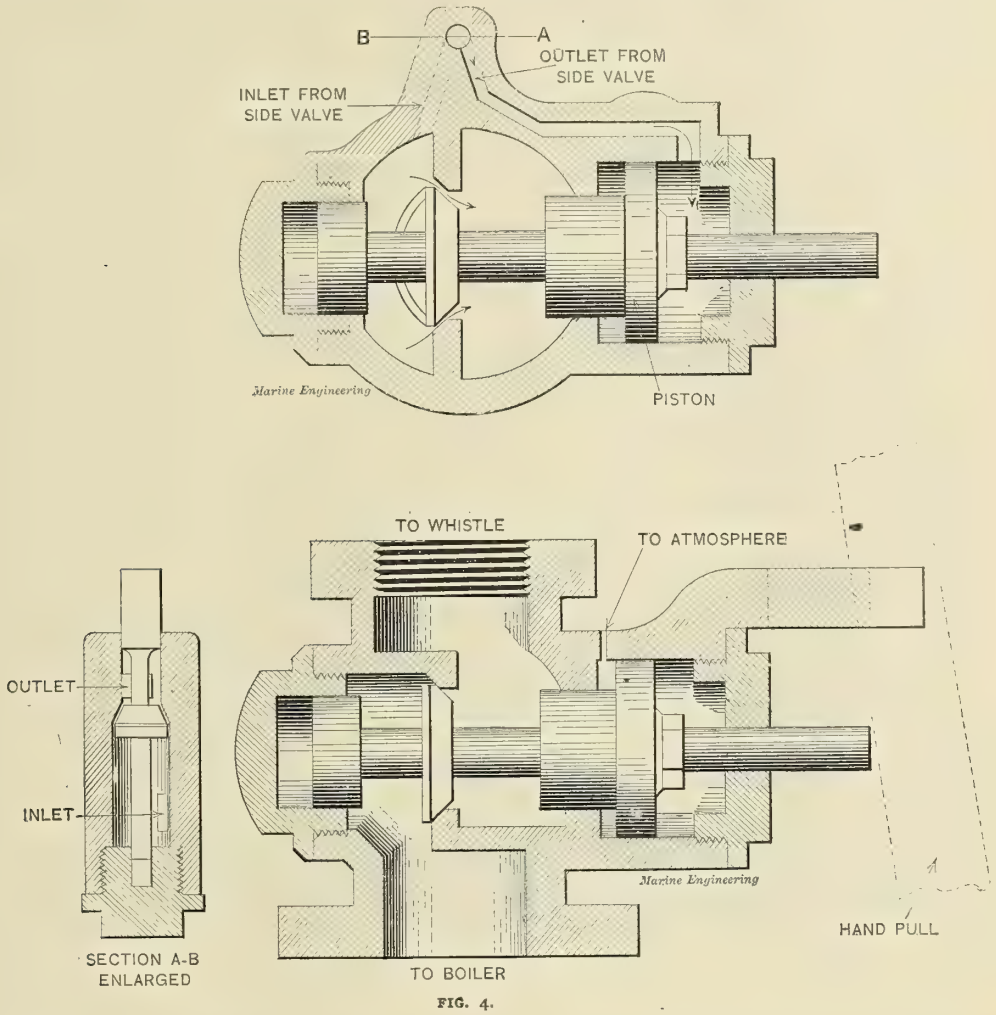


FIG. 4.

If it is desired to operate the whistle from the chart house or similar protected position, a strap key or a push button will answer instead of the water-tight switches used in the exposed positions. The only attention required is to wind the clockwork at intervals of four days, taking care not to wind too tight.

The switches should be examined occasionally, and any trace of corrosion removed, and the working parts slightly oiled with vaseline, which will tend to prevent further corrosion. In installing this apparatus, due to its exposed position, it is generally required that the wires be carried in conduits, and in this event care should be taken to provide for the expansion of the piping when fires are lighted under the boilers, and the piping up the funnel to the whistle should be fitted with a slip coupling or a goose neck bent in the pipe. If the wires

By properly proportioning the batteries and the use of a small resistance in the circuit when dynamo current is used, and using a double-throw switch, either source of power could be used. Thus if a set of batteries has 20 volts and the dynamo has 110 volts, by placing a resistance of such a value that it will dissipate 90 volts, 20 volts will remain of the 110 volts, and then when the double-throw switch is thrown in either direction the voltage would be alike. By this means a large set of batteries would be avoided and the whistle could be operated from either source.

As all the terminals are numbered, it will facilitate matters to trace the circuits thus:

1 and 2, to dynamo or battery.

3, 4, and 5, to whistle switch.

6 and 7, to whistle magnet.

An additional attachment is provided whereby the time of sounding the blast is recorded. It consists of a clockwork mechanism operating a set of dating wheels, over which are fed the printing ribbon and the paper record. The printing hammer (which strikes the record paper over the dating wheels) is operated by a lever connected to the rod of a vacuum piston. The vacuum piston is normally held up by a spring, but when a vacuum is produced on the lower side of the piston atmospheric pressure forces the piston down and operates the printing hammer. The vacuum piston cylinder is connected by an exhaust pipe to a chamber into which steam may be admitted when the whistle is blown, creating a partial vacuum around the mouth of the exhaust pipe and exhausting the air from the vacuum cylinder. A cam on the lever allows the printing hammer to return and clear the record paper, so that in case the blasts are sounded rapidly, with short intervals, there will be no aberration of the record. The printing ribbon and record paper being fed by the movement of the piston, the spacing of the record will always be in exact proportion to the interval between blasts; and the dating wheels being operated by the clockwork, there is no likelihood of confusion in reading a printed record. The recorder has attached the contact-making device similar to that above described for connection with the automatic operator, combining the two instruments in one.

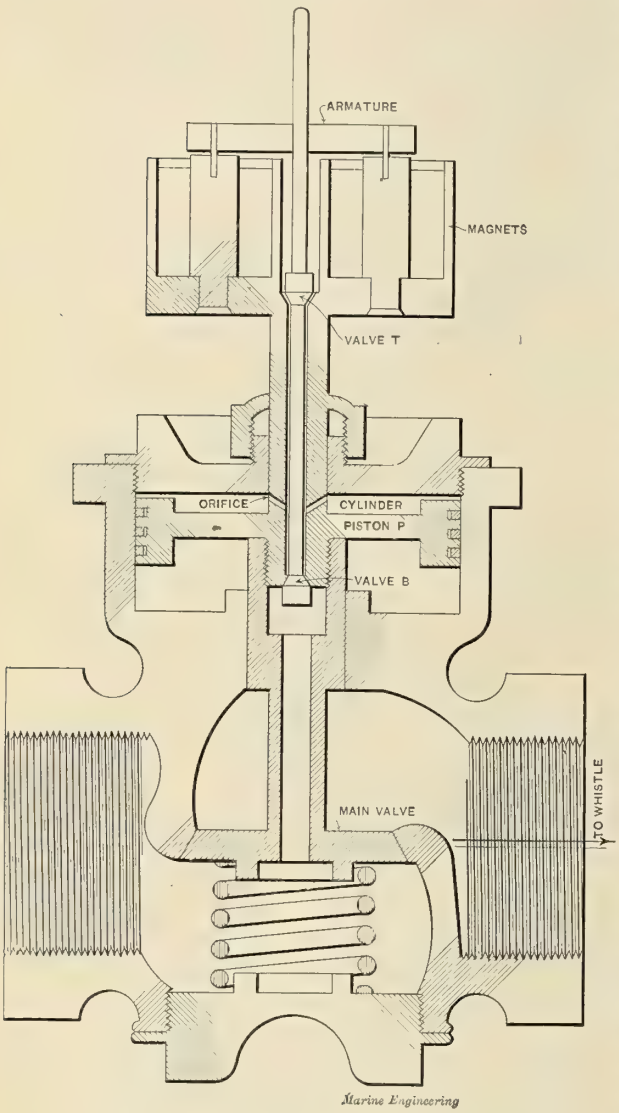


FIG. 5.

The use of the automatic operator and recorder is strongly recommended as an additional safeguard to navigation. The automatic operator eliminates any possibility of sounding incorrect signals (as is liable in case of manual operation) and spaces the interval and the length of blast accurately to a fraction of a minute. The recorder makes a record of the signals at all times, acts as a check on the log of the ship, shows accurately if the proper signals were sounded at the proper time, and thus in case of accident furnishes positive evidence regarding the point.

Another form of electrically-operated valve is shown in Fig. 5. When the operator closes the switch the magnets are energized and the armature attracted. The armature carries the valve stem and is forced downward when the magnets are attracted, closing the small valve *T* and opening the small valve *B*, admitting steam to the hollow stem of the main valve through *B* into the piston cylinder, where the steam acts to force the piston downward and thus opening the main valve and admitting steam to the whistle. Steam will flow to the whistle as long as the magnets are energized, but when the switch is opened and the armature is no longer attracted, the steam pressure on bottom of small valve *B* forces this valve closed and opens the small valve *T*, allowing the steam in the piston cylinder to escape to the air. The pressure being thus relieved from piston, the pressure acts to close main valve. The spring shown supporting the main valve acts only to support the weight of the valves and armature, so that quick action may be secured and the operation adapted to signaling.

A Floating Workshop.

The delay occasioned in ship repair in carrying the material from the vessel to the shop and return has always been recognized as a source of expense to the shipbuilder. It is, therefore, interesting to note the floating workshop which has recently been added to the plant of Messrs. Mordey and Carney, of Southampton, England. This workshop is 76 feet long, 30 feet wide, square-built of iron, and is much the same in appearance as one of our housed-in lighters in use in our harbors. The machinery includes a portable engine and boiler for driving purposes, a pneumatic compressor and receiver for operating pneumatic tools, a punching and shearing machine, drills and shapers, lathes, smiths' forges, grindstone, vise benches, tools, and stores for machinery—in fact, all that is required to facilitate the carrying out of large repairs to hulls or machinery. In addition, there is a small dynamo for supplying electric light to the shop and to that part of the vessel where the repairs are going on.

This unique shop is towed alongside of the steamer which is to be repaired, or, if the vessel is dry-docked, the shop is taken in the dry-dock, close to the ship.

Trial Trip of the Worden.

On September 11 the torpedo-boat destroyer *Worden*, built by the Maryland Steel Company, Sparrows Point, Md., underwent her official trial over the Barren Island course with most gratifying results, which are given as follows:

Run. No.	Time.	Total Rev. Star.	Total Rev. Port.	Rev. per Min. Mean.	Speed.	Steam Star. Eng.	Steam Port Eng.
1 S.	2.30 4/10	642	622	252.1	23.936	125–115	120–120
2 N.	2.34	665	650	256.2	23.376	125–120	125–120
3 S.	2.18	650	637	280.0	26.086	145–160	150–156
4 N.	2.22 8/10	672	657	279.1	25.210	150–155	150–152
5 S.	2.10 8/10	651	639	295.8	27.522	175–180	175–178
6 N.	2.14 1/10	674	664	298.5	26.765	175–180	175–177
7 S.	2.03 7/10	660	651	318.2	29.09	200–210	200–210
8 N.	2.06 7/10	684	674	321.6	28.41	210–210	205–210
9 S.	1.58	671	668	340.5	30.508	240–237	230–232
10 N.	2.03 2/10	690	689	335.8	29.22	232–230	225–225

THE U. S. TORPEDO-BOAT DESTROYER WORDEN, MAKING 29.86 KNOTS ON TRIAL.

It will be noted from the above table that the highest speed obtained on any one run was 30.5 knots, which, with the tidal corrections, gives a true speed of 30.05 knots, and the average of the last two runs gives a mean speed of 29.86 knots. These records were obtained on the standardization trial, and on the following day the one-hour run was held and an average speed of 28.15 knots was obtained for the required time.

In all these runs the *Worden* behaved beautifully, not the slightest accident or mishap occurring to spoil the good record.

Torpedo-Boat Destroyer Goldsborough.—The torpedo-boat destroyer *Goldsborough* on September 10 again went out for Government trial trip from Seattle, and, it is reported, had reached the required speed of 28 knots and was about completing her trial, when the port engine broke down and became completely wrecked.

The Influence of Shoal Water on the Speed of Vessels.

BY A. E. LÜDERS.

In the October number of MARINE ENGINEERING there appeared an article contributed by a Mr. A. D. Stevens dealing with the effect of shoal water upon the speed of ships. In his paper he set forth that the *limit* of speed attainable for a given hull, irrespective of linear dimensions, displacement, or draft, is governed entirely by the speed of the following wave—*i. e.*, "wave of translation" or "displacement"; that is to say, a vessel cannot go faster than the wave it carries behind it, and, as the speed of a wave in shallow water is given by the formula

$$V = \sqrt{gh},$$

where V = velocity of wave in feet per second,
g = acceleration due to gravity,
and h = depth of water in feet,

he argues that this value V is the maximum theoretical speed of a vessel in water corresponding to a depth h; the object of the designer being to design a hull that shall be capable of approaching this speed as nearly as possible.

There is another side to the question, and one that seems to have been overlooked—namely, the possibility of there being such a speed that the ordinary laws of resistance become more or less modified, and the probability of the character of the "wave of translation" changing so that the formula no longer holds good. The fact that Mr. Stevens was not able to record any such speed would not necessarily preclude the possibility that such a speed existed, but rather that he did not have sufficient power in his boats to prove the fallacy of his conclusions.

That a speed greater, for a given depth of water, than he mentions can be and has been obtained is shown

by the speed trials in shallow water of various Danish naval vessels. The reader is referred to the transactions of the British Society of Naval Architects, 1899, in which a paper appears by Capt. A. Rasmussen, of the Danish Navy, giving the results of the above-mentioned trials. As the article in question is not accessible to many, a few references to his work might not be out of place.

The trials were carried out by two torpedo boats, one the *Markrelen,* length 145 feet 6 inches, beam 15 feet 6 inches, draft forward 3 feet 10 inches, aft 7 feet 9 1-2 inches, and a displacement of 140 tons; the other boat, the *Söbjörnen,* was 140 feet long, 14 feet 3 inches beam, a draft aft of 7 feet 4 inches, and the displacement at that draft 127 tons; a patrol boat of about 36 tons displacement was also experimented with. The trials consisted essentially of speed trials in various depths of water, ranging from two fathoms upward. From the data obtained curves of I.H.P. and speed were plotted, and an analysis of these curves presents several interesting features.

In the first place, instead of the horse-power curve following the general parabolic form, it presented a distinct wave or inflection point at about what is considered a good speed for the size of vessel. After the inflection point was passed the slope of curve was considerably less than before that point was reached, after which the tendency of the curve was to again resume its normal character. From a curve having such characteristics we would rightly conclude that, in the case of a vessel traversing shoal water, the horse power will increase steadily as speed is increased, until a certain "critical speed" is reached. After passing that speed a comparatively small increment of power would greatly increase the speed, after which, again, increased power would only accelerate the speed at the usual rate.

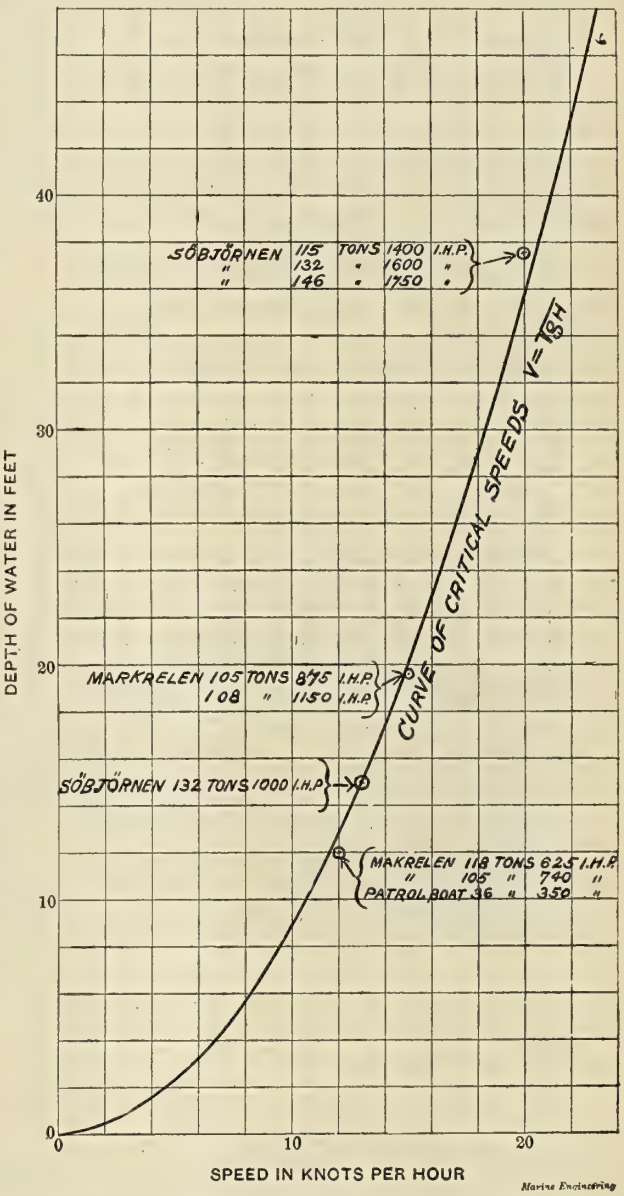
For example, take the case of the *Söbjörnen* at 132 tons displacement; in that condition the I.H.P. for a speed of 12 1-2 knots in 2 1-2 fathoms of water was 800; an increase of 200 horse power gave 13 knots, while another 200 horse power brought the speed up to 16 knots; the increase after the critical speed had been passed being 600 per cent. of that which occurred just previous to reaching that point.

That this phenomenon gradually disappears as the depth of water increases goes without saying. This critical speed is independent of size, displacement, draft, etc., of boat, it being governed entirely by the depth of water.

From the above we see that Mr. Stevens was in error by entertaining the idea of a limiting speed for a certain depth of water; in fact, a further analysis of the trials showed that it was possible to get an even greater speed in very shallow water than when the depth was very great.

The explanation of the above is that, as the speed of the ship is increased in shallow water, the boat gradually mounts on the crest of the wave of translation, and, owing to the shallowness of the water, eddies and waves that would be the result of high speed in deep water have not room to form, owing to proximity of keel to bottom of the water, and thereby a source of resistance is eliminated, and naturally a higher speed is possible.

In comparing Mr. Stevens' curve (see figure) with the critical speeds of the various boats experimented with, it will be noticed that the curve agrees almost exactly with those points. From this we see that the curve under discussion does not represent the limit of speed for a given depth of water, but does give us a "critical speed," for a certain depth of water, at which it would be manifestly uneconomical to attempt to drive a vessel.



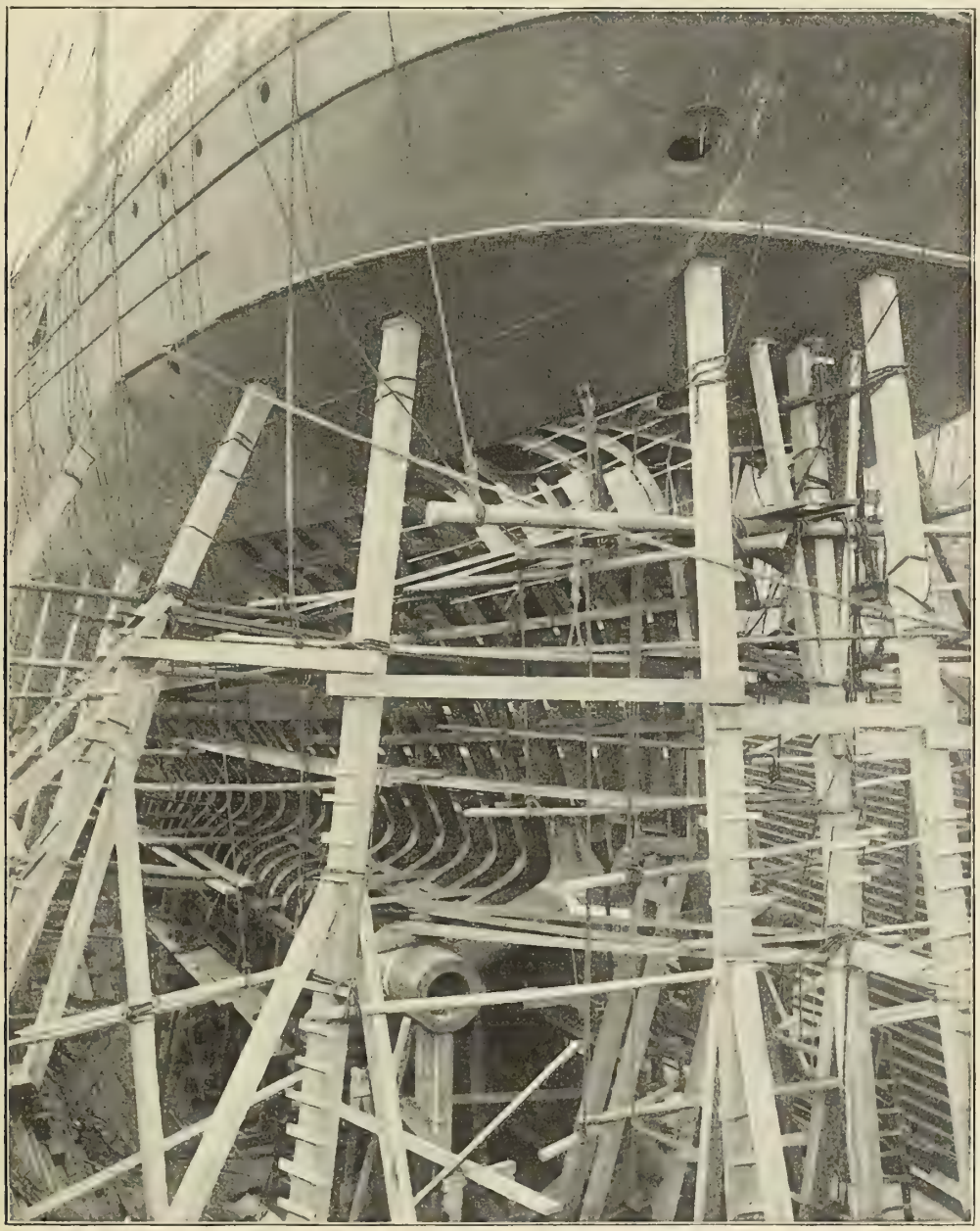
POINTS RECORDED ON THE CRITICAL SHOAL WATER SPEED CURVE.

With this curve there will be represented graphically just which speed it is advisable to avoid for a given depth of water; the manner of avoiding it—that is to say, whether the ship should be driven at a speed less than the "critical speed" or at one considerably in excess—is a point to be decided by the designer, who should be governed by the service for which the ship is destined.

Repairing the Steamship New York.

As most of the readers of Marine Engineering are aware, the steamship *New York,* of the International Navigation Company, is undergoing very extensive repairs to hull and machinery. Twelve months ago the vessel was towed from Philadelphia to the John N. Robins Company's dock at Erie Basin, South Brooklyn, and still remains on the keel blocks. The principal alteration is at the stern, where the plating, framing, and stern post were removed and replaced by spectacle framing for inclosing the two shafts within the hull plating as far out as the propeller. A stern post was fitted to take new brackets. The entire hull was gone over, and all butt straps replaced by new ones. As soon as the work on the hull is completed, the ship will return to Cramp's yard, where new engines and boilers, which are now building there, will be installed. It is doubtful whether any of the $1,250,000 estimated for the repairs of this ship will be left after this extensive remodeling and re-equipping.

Since writing the above, the work of fitting on the massive propellers of the *New York* has been completed at Erie Basin. The propellers have three bronze blades each, and the hubs are of cast steel, each blade being bolted to the hub by chain bolts with bronze ends. Around the bases of the blades are heavy circular plates of zinc to prevent corrosion. Each hub weighs about 13,500 pounds, and the three blades about 28,300 pounds. It is expected that the vessel will soon be floated from the dry-dock.



Marine Engineering

Published Monthly by

MARINE ENGINEERING,
INCORPORATED

309 Broadway - - - New York.

H. L. ALDRICH, President and Treasurer.

PROF. W. F. DURAND, Advisory Editor.
F. D. HERBERT, Associate Editor.
G. SLATE, Advertising Representative.

Branch Offices.
Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. Anness.
Chicago, Ill., 1643 Monadnock Building.
Boston, Mass., 170 Summer St., S. I. Carpenter.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada and Mexico	$2.00	20 cents
Other countries in Postal Union	2.50	25 cents

Entered at New York Post Office as second-class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE question of oil fuel and its adaptation to the needs of the marine engineer is one which presents itself with increasing emphasis as time and study bring the various practical difficulties more or less satisfactorily under control, and reports from nearly all maritime nations show that the subject is attracting increasing attention, and that oil-fuel equipment is being widely installed where the special conditions favor such policy. There has been, of course, no fundamental difficulty with the use of oil fuel. Such difficulties as have arisen have been in connection with the details of the equipment, and have affected only the details of operation. Thus troubles have arisen in connection with the clogging of burners with a tenacious deposit of unburned carbon, with the formation of smoke, especially under forced conditions, with noise, with odor, with the expenditure of fresh water when steam is used as the atomizing agent, with the presence of water in the oil, putting out the flame at the burner and introducing the danger of explosions in the furnace. There has been, furthermore, great uncertainty regarding the probable cost in case the demand should be largely increased, and regarding the certainty of the supply and the readiness of obtaining such fuel except at a limited number of points of supply.

One by one these various points have been made the subject of special study, and it can fairly be said that the mechanical difficulties in connection with the combustion of the oil are well in hand, especially when the rate of combustion is moderate. Perhaps the most serious question in connection with the use of oil fuel for naval purposes is the difficulty of maintaining the highest rate of combustion, or of realizing, under hard-forced conditions, the output per pound of boiler which is possible with coal.

The recently-published volume of the Office of Naval Intelligence contains a comprehensive résumé of the progress along these lines, and we would recommend all of our readers who may be able to do so to carefully read this article. In Russia, Great Britain, Holland, Sweden, Germany, Austria, France, and Italy, outside the United States, the question of oil fuel is attracting keen interest and study, with an increasing number of installations for marine purposes. On one point the best practice seems agreed, and that is that steam cannot be afforded as a spraying agent, due to the consequent waste of fresh water. Air under high pressure, and air under low pressure, with various means for insuring the mixture of the oil spray and the air, are under experimental study and in actual use. One further point seems clear, and that is that no one system in detail is equally suitable for the combustion of the various grades of oil fuel, from the Caspian residue Astalki, through the various grades of oil found in different parts of the world. It will be very strange, however, if from the study and engineering effort now being directed along these lines there does not result information adequate for the more intelligent guidance of the engineer in his choice of methods for the use of this fuel.

THE opportunities for young men in the various fields have been more or less exploited in current literature, but there seems to be little general information concerning the openings offered in the line of practical marine engineering. The technical schools and colleges are turning out each year classes of young men who go into the shipbuilding industry; but the usual requirements of the engine room are not so much for technical

training as for practical experience, and the openings are not such as have usually attracted college graduates. The engine room of merchant and war ships must, of course, be supplied with men of skill, if machinery is to run. The designer and engine builder deliver to the owner a complicated mechanism that must be carefully operated and maintained at highest efficiency. In the big ships each and every one of the numerous auxiliaries must be watched and kept in order, and the men that fill the position of chief engineer have an amount of responsibility that deserves large compensation. As mechanical power is increasingly substituted for hand power, and the deck department of a big ship is being equipped with innumerable machines more or less intricate, the relative importance of the engineer to the captain is daily increasing.

Men to fill such positions must have ability and a long experience, which latter may only be secured by entering the profession at an early age. This is one department where the practical man reigns supreme, for no amount of theory will equip a man for operating an engine. Therefore, here is a field where the young man mechanically inclined, who cannot afford a technical education, may enter and have fair prospects of advancement and fair pay. After he has started at work his promotion will be surer if he will devote his spare hours to study, preferably under the guidance of a correspondence school.

We have received so many letters asking about this service from young men all over the country that we recently sent out inquiries to the leading steamship companies concerning the requirements for young men entering the engine-room department. On other pages of this issue will be found extracts from many of the replies received, which generally present a cheerful outlook for young men seeking such employment. By reading these letters, one is convinced that there is plenty of room for good men in this profession. In many of the companies new men are taken on as oilers, which obviates the necessity of first filling the trying positions of coal passers and firemen. This work is hard and confining, and to undertake firing a marine boiler requires a strong constitution and plenty of muscle. Then, in sea service the ship is away from the home port for days or weeks at a time, and when she returns there is always hard work ahead in overhauling and repairs, which gives an engineer but little time to himself. Notwithstanding these trying conditions, it is seldom that a man who once secures an assistant engineer's license is found to go back to a shore position.

Requirements for entering the Government service are more rigid, and the examinations cover elementary subjects and somewhat advanced engineering. There are but few positions open, but these pay well, the engineers receiving the same pay as officers of equal rank in the army.

Young men about to choose a profession and who are of a natural mechanical bent would do well to consider the openings in the practical side of marine engineering.

A RECENT announcement in the press states that in a storm on the Great Lakes two vessels foundered. This announcement is likely to awaken different sentiments in the minds of those who may read, according to their individual interests. To the owners will come reflections on the uncertainties of the shipping business, financial loss, etc., aside from the loss of human life. To other owners in competing business will come the thought that so long as no lives are lost the competition may well be spared, while to the builder will come similarly the thought that something new will be required to take the place of the old, and that, after all, it's an ill wind that blows no good. It may fairly be questioned whether, outside of those suffering direct loss, such accidents are taken as seriously as they deserve. An accident is an occurrence more or less unforeseen, or due to conditions more or less beyond direct human control. In most accidents, however, there is no fundamental necessity, and a little keener foresight or a little better provision would have served to prevent. An accident usually happens because in the struggle of opposing forces tending toward safety and destruction, the latter, due to some minor initial cause, obtain the upper hand, and destruction follows. How little, in most cases, would be required to cause the balance to incline the other way and to insure the triumph of the forces tending toward safety! The preservation of our ships and shipping is a most complex matter. It is in the hands of designers, builders, owners, Government inspectors, operators, and, lastly, the general public. Are all of these varied influences at work harmoniously and with serious effort to insure the highest safety of American shipping, with the lives and property committed to its charge? We fear that the answer at most could be only a qualified affirmative.

Troubles with and Remedies for Leaky Pipe Joints.

BY C. A. MCALLISTER, CHIEF ENGR., R.C.S.

Joints, as every marine engineer knows, are a very important thing on board ship, as well as elsewhere, but particularly so around marine work. To the engineer on watch nothing is more annoying than to have a joint blow out, especially as they almost always do so at a time when they shouldn't. Seldom does a joint give out when a vessel is tied up to the wharf and you have plenty of time to fix it up. No, they seem to wait until just as you are getting under way or ready to cast off from the wharf, and those that don't give out at that time usually wait until you get well outside and are bucking into a nasty headwind and sea. If you are bound to the southward in the winter time they will kindly postpone their "blowing" until you get well out of cool weather and down around the equator, where even a thermometer would complain of the heat. Then, too, "blowing" joints are quite particular as to their location. Most well-regulated joints would feel mortified if they should blow out in an accessible place. If there are five joints in a line of pipe, with four of them that can be easily reached, you always find that the fifth one, close up under a deck beam and back of a blower or pump, is the one that starts to sizzle and sputter in a spiteful sort of mood, as much as to say, "Get at me if you can." Then comes the weary second assistant with a coal passer to help him "get at" that sizzling joint. They stand on their heads, hang on with one hand and two fingers of the other, then try to work with the remaining three fingers, and finally ascertain that there is no wrench on the ship that will reach the two nuts at the back of the joint. Then they take an open-ended wrench and bend it until it looks like a cow's horn. After experimenting with it for another ten minutes they find that in a certain position they can get about a sixty-fourth of a turn on each nut. Finally, after numerous burns and an exhausted vocabulary of profanity, the spitting and sizzling is stopped temporarily, only to break out again at some other inopportune moment. After a few such experiences most engineers will agree that there are two principal classes of joints, viz.:

1. Joints that leak.
2. Joints that don't leak.

To get all the joints about the steam machinery into the class of those that "don't leak" is the desire of every engineer who goes to sea. To attain this delightful condition of affairs is something that is seldom accomplished, except for short periods at a time. When you consider the hundreds of joints which are necessary to connect up the various parts of the machinery of an ocean-going vessel, it is but little wonder that some of them are always leaking.

To have joints tight depends about equally upon two things, the first of which is that they must be well designed, and the second is that they must be given intelligent attention. While it is well-nigh impossible to make a poorly-designed joint tight by the most skillful attention, the opposite condition of affairs holds with about equal force.

In the design of flanges for joints great care must be exercised to see that the following conditions are fulfilled:

1. That the pipes are properly secured to the flanges.
2. That the flanges are of sufficient thickness.
3. That there are a sufficient number of bolts and that they are properly spaced.
4. That the faces of the flanges are of sufficient width.
5. That the flanges are exactly parallel and do not have to be sprung together by the bolts.

If any of these conditions are neglected, then trouble will be encountered in keeping the joint tight. The most frequent fault met with is that pipe flanges are made too thin, especially if they are of composition, where, in order to save metal, the efficiency of the joint is sometimes sacrificed.

Frequently joints are designed for high steam pressures, where the bolts are spaced so far apart that the gaskets will blow out between them. Sometimes the gaskets have to be put in so narrow that they blow out from this cause alone, although most joints are made amply wide, providing the other requisites for a good joint are carried out. There is great need of a universally-adopted standard in the matter of pipe flanges. As it is now, each shipyard has its own standard for these most important details—some good and others decidedly indifferent. The Government has a standard for pipe joints designed for different pressures, and a number of yards which do navy work have adopted this standard in order to save a complication of patterns.

Attention to small details, such as flanges, goes far toward the successful operation of marine machinery. There is but little doubt in the minds of most engineers that the superiority of the far-famed *Oregon* is to no small extent due to the careful manner in which even the most minute details were worked out. Among these, none was of more importance than the tight joints due to the careful designing and fitting of the numerous pipe flanges.

Of almost equal importance to the flanges themselves are the gaskets fitted between them. While it is true that the best joint is one where no gasket at all is used (that is, the ground or scraped joint), its great expense and the fact that it must be kept permanent precludes its use except in comparatively few cases. Gaskets, therefore, must be used, and one of the objects of every painstaking engineer is to get the best gaskets for the purposes intended. Not so very long ago there was but little choice in gasket material, as the ordinary rubber and canvas article was about all that was available. With the advent of higher steam pressures the ordinary rubber gasket was found to be unsuitable for the increased temperatures. The demand has been promptly met by a number of patented materials, several of which are most excellent. Many engineers insist that nothing is better than usudurian and wire gauze, and as a matter of fact it is hard to beat. For joints in water pipes the old-fashioned rubber and canvas material is still much used, although it does not last so long as some of the patented packings. Gaskets made of asbestos in one form or another have met with much favor, especially for high steam pressures. For cylinder and valve-chest cover joints there is probably nothing made that can equal it for durability and efficiency. The experience of many has been that where it is used for joints of pipes through which water is liable to be carried with the steam, it soon gives out. The hot water softens it and it gradually washes away.

The writer knows of one case where no less than twelve turns of 1-inch asbestos round packing were used in the slip joint on a 12-inch main steam pipe, and in less than a week's time it had to be entirely repacked. The boilers had foamed considerably and the action of the water in the steam had simply washed the asbestos out of the joint. Various combinations of rubber and soft metal have been invented, and some of them give very good satisfaction. Then, too, soft metal, such as copper, is used for gaskets, with more or less success, depending upon how carefully it is fitted. In locomotive practice a very efficient joint is made by brazing together a piece of 7-16-inch copper wire and fitting it inside of the bolts of the flange. The wire is annealed before being put in place, and is held in position by three or four spots of solder. One of the flanges is also grooved to fit over the wire. This makes an excellent joint and one that could very readily be adapted to certain parts of marine work.

For permanent joints, such as those on boiler fittings, some engineers still cling to the old-fashioned cement style, made of red and white lead and iron filings mixed up to the consistency of putty. This mixture put between two pieces of wire gauze makes a very serviceable joint, if properly mixed and applied.

If shipbuilders would furnish a set of sheet-iron templets for the various sizes of pipe flanges on board ship, many blessings would be heaped upon their heads by the poor unfortunates who have to yank the pipes apart to get the diameter of the bore of the pipe and the spacing of the bolt holes. For a few dollars' expenditure in the outfitting of a ship a complete set of these useful things could be furnished. They could be marked without much trouble and would stow away in a very little space. Another convenience to the joint-maker is a gasket cutter, a very simple contrivance, something like a beam compass, yet one which saves considerable labor and makes neater work than is accomplished with a knife. Punches for the various sizes of holes from 1-2 inch up to 1 1-2 inches come in very handy, as it takes a very skillful man to carve a hole that is exactly round with only a penknife to work with. Much trouble will be avoided if the carver-out of gaskets would leave an ear or projection on the outside to assist in adjusting them in place. The ear can very readily be cut off after the joint is set up. No gasket should ever be put in place until it has been coated on both sides with a coating of blacklead or plumbago and oil or tallow. He who neglects this important step in joint making will live to regret it if he happens to be around when that joint has to be remade. One or two experiences of scraping the remnants of a baked and hardened gasket off a flange will serve as a good aid to memory for the future.

In making joints in steam pipes they should always be "followed up," as the saying goes, after the steam has been turned on. No matter how tightly the nuts have been set up when cold, you will always find that you can get a little more on them after the pipe and flanges have been thoroughly heated. Temperature has a great deal to do with tight joints. Inexperienced people often think that joints are done for, when, as a matter of fact, the pipes have been filled up with water, which has started them leaking. A joint that will be perfectly tight under a high steam pressure will frequently leak if cold water is allowed to collect in the pipe. This is simply due to the expansion of the metal when the greater heat of the steam is applied. Draining a pipe thoroughly often saves the making of a new joint to replace one that is supposed to be worn out.

ENGINEERS' DICTIONARY.—XXXVIII.

Reversing Engine. In large marine engines the valve gear is too heavy to be controlled or reversed by hand, so that it becomes necessary to provide a separate and special engine for this purpose. This is known as the reversing engine.

Reversing Gear. A general term referring to the entire mechanism employed for reversing or controlling the valve gear.

Reversing Lever. A lever operated by hand and connected with the valve for operating the reversing engine. By means of a lever the reversing-engine valve is under control of the operator, and through this the reversing engine itself, and hence the main valve gear, and through this the main engine.

Reversing Shaft. A shaft usually carried either on the front or back of the columns near the top and to which are secured arms connected by rods to the main engine links. The reversing-engine piston rod is also connected through a suitable connecting rod to another arm of the same shaft. By this means the motion of the reversing-engine piston is transformed into a partial rotation of the reverse shaft, and through the reverse arms this is transformed into the required movement of the main engine links. The reversing shaft is also quite commonly known as the *weigh* shaft.

Reversing Propeller. A form of propeller usually having but two blades, each of which is mounted on a pivot or in a socket in such a manner that it may be rotated about an axis along its length to a sufficient extent to change the general direction of its obliquity from right hand to left hand. In this manner, with the shaft turning constantly in one direction, the propeller may be transformed from go ahead to back, or vice versa. It must be understood that a propeller of the usual form, right-hand for example, cannot be transformed by any such twist of the blades into a true left-hand propeller. Furthermore, the blade necessary for satisfactory operation with a reversing propeller must be a mean between the two forms required for right- and left-hand propellers. For this reason it is unable to operate with the highest efficiency in either position, and such propellers can hardly be considered advisable when considerations of the highest efficiency are of importance. They are, however, of great convenience in connection with many modern forms of gasoline engines in which the shaft is allowed to rotate continuously in one direction while the reverse is effected by shifting the blades in manner indicated. For an intermediate position the plane of the blades will lie nearly transverse, and in consequence the boat will be urged neither ahead nor back.

Rock Shaft. A name sometimes given to the reverse shaft.

Red-Lead Joint. A joint or connection between two surfaces made tight by the use of a putty composed

of red lead and oil. Such joints, if allowed to harden somewhat before being subjected to the influence of steam or pressure, remain tight for indefinite periods of time. The proper making of a red-lead joint requires care in mixing the putty and in the arrangements for securing it between the surfaces of the joint. Red lead with oil in one form or another forms one of the standard materials for the making of joints.

Rotary Engine. An engine in which the moving parts have a motion of rotation only. Thus the steam turbine is a form of rotary engine. Rotary engines have been designed in a great variety of forms. In the turbine the steam is utilized in the form of a jet or vein rushing with great velocity along the curved side of a series of blades carried on a revolving runner. In this way the steam is used in a manner similar to water in the turbine water wheel. In other types of rotary engine the steam acts more directly by pressure and expansion, as in the common steam engine. But little success has been attained in the development of rotary engines of the latter type. The turbine has, however, been developed to a high degree of engineering efficiency, and it has already established itself in the field of marine propulsion.

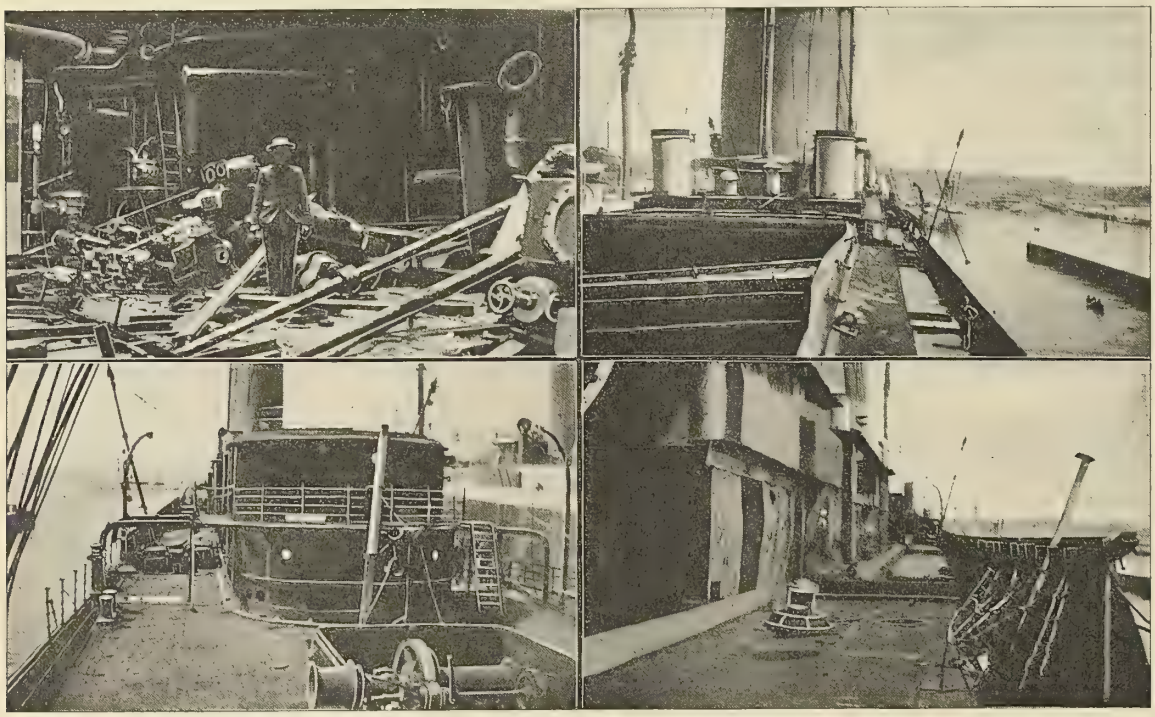
Rust Joint. A joint made between two surfaces by the use of a mixture of iron filings and sal-ammoniac moistened with water. This gives rise to a series of chemical actions resulting in the rusting of the iron, accompanied by an expansion in bulk and the formation of a hard compact cement. Rust joints can only be recommended for emergency repairs or for locations where there is no occasion to take the joint apart, as it is with difficulty that the surface of the flanges may be cleaned at a later day.

The Burned Saale.

The reconstructed *Saale* was described in August last, and since then a contributor has forwarded the following snap-shots, taken after the *Saale* was moored at the Townsend-Downey Shipbuilding Company, following a short time after the fire.

The views speak for themselves the damage which this ship sustained, both to hull and machinery. The plates of the deck and deck houses were badly warped and bent by the intense heat, and the engines were a complete wreck.

The view in the engine room shows to what an extent the machinery was damaged; the main engines fell down and the auxiliaries on top of them, leaving nothing but a mass of scrap. The lower left-hand view is of the deck, taken after the ship was rebuilt.



VIEWS OF THE BURNED AND RECONSTRUCTED SAALE.

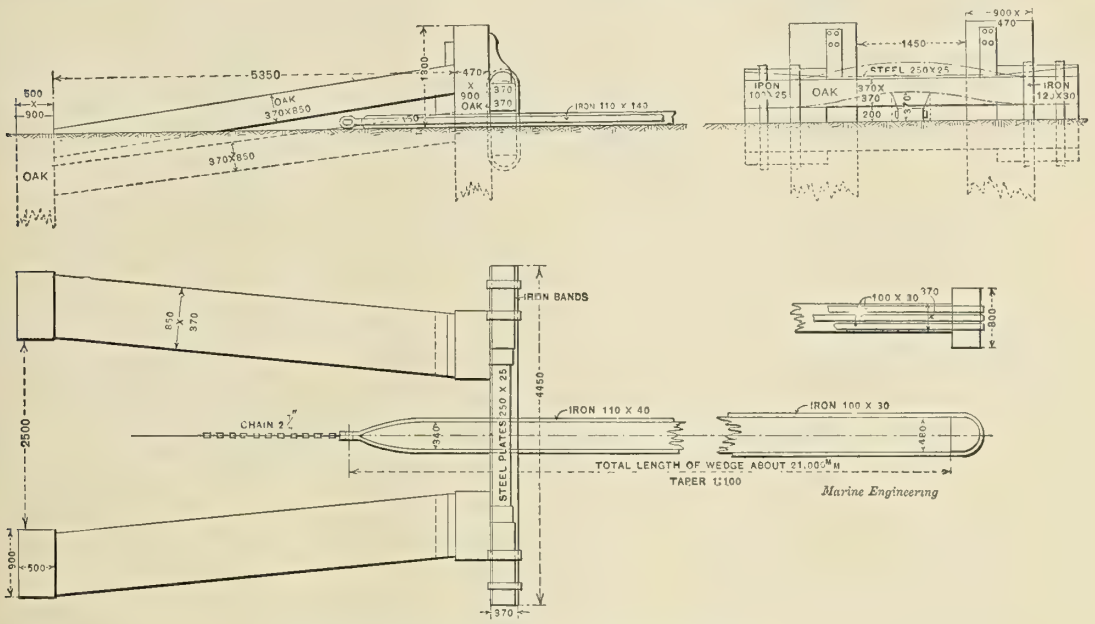
The third view was taken on the upper deck looking aft, and shows the twisted hatch coamings. The lower right-hand view was taken from the promenade deck looking aft, and here the warped deckhouses and bulwarks, stanchions, etc., are clearly shown.

Fuel-Oil Steamer.—The former transport *Rosecrans*, recently purchased by the Matson Navigation Company, is now undergoing alterations at San Francisco for use in the oil trade between the coast and Hawaii.

Annual Report of General Dumont.—The annual report of General James A. Dumont, Supervising Inspector General of the Steamboat Inspection Service, shows that the number of lives lost on steam vessels from various causes during the year ending June 30, 1902, was 445, an increase of 110 over the previous year. The total number of steam and motor vessels inspected during the year was 8,761, and the sailing vessels and barges inspected numbered 500.

Launch of the Kaiser Wilhelm II.

In launching the mammoth North German Lloyd steamer *Kaiser Wilhelm II.* the builders, the Vulcan Company, of Stettin, Germany, not only had a problem to successfully carry the vessel into the water, but also to stop her after she was water-borne. To bring the ship to rest two anchors were thrown overboard as soon as the vessel floated. On the starboard side there was bolted near the stern a large forging with eye-bolts for securing several chain cables. One of these cables was connected to a series of large wooden disks which floated vertically in the water, one disk after the other being brought into play as the cable became taut. The final stopping, however, was provided by friction brakes in the form of long wedges. These are not new to German practice, but are unusual elsewhere, and are much to be preferred to heavy weights, which are frequently used and drawn down over the ground of the shipyard.



BRAKES USED FOR SNUBBING THE KAISER WILHELM II.

The brake is simple and consists of a wedge-shaped log of oak, bound at the sides with steel plating, and having at the end an eye-piece to which is secured the ship's cable. These brakes are drawn through oak framing consisting of two horizontal beams firmly secured by wedging steel bands between vertical piles and stayed by heavy shoring.

As a result of bringing these successive systems into operation, the ship was gradually stopped without straining. For the above facts and illustrations we are indebted to the London *Engineer*. Dimensions are given in millimeters.

Atlantic Steamship Combination.

The International Mercantile Marine Company is the name of the great Morgan shipping combine which has taken over the properties of the American, Red Star, Atlantic Transport, White Star, Dominion, Leyland, and Holland-American lines of steamers, and also the great shipbuilding plant of Harland and Wolff, Belfast, Ireland. The new company is an enlargement of the International Navigation Company, a New Jersey corporation, which operates the American and Red Star lines. The capital of the International Mercantile Marine Company is $60,000,000 preferred stock and $60,000,000 common; an issue of $75,000,000 4 1-2 per cent. debenture bonds is also provided for. The new company will have the following-named officers and directors:

President—Clement A. Griscom.

Vice-President—Right Hon. W. J. Pirrie.

Directors—C. A. Griscom, P. A. B. Widener, B. N. Baker, John I. Waterbury, George W. Perkins, E. J. Berwind, James H. Hyde, Charles Steele, Right Hon. W. J. Pirrie, J. Bruce Ismay, Sir Clinton E. Dawkins, Henry Wilding, Charles F. Torrey.

Executive and Finance Committee—C. A. Griscom, P. A. B. Widener, George W. Perkins, Edward J. Berwind, Charles Steele.

British Committee—Sir Clinton E. Dawkins, chairman; the Right Hon. W. J. Pirrie, J. Bruce Ismay, Henry Wilding, Charles F. Torrey.

The majority of the Board of Directors is composed of Americans, so that the control is vested on this side. In regard to its relation to the British Navy, it is announced that the British companies will retain the subventions they are now enjoying; the combine is to receive equal treatment with lines not included by it in the matter of mails and other contracts, and in case of war Great Britain may purchase or charter any of the combine's ships flying the British flag.

Through subsidy arrangements control of the North German Lloyd and Hamburg-American steamship companies is virtually vested in the International Mercantile Marine Company, which thus embraces all of the large lines excepting the Cunard Line. According to the new schedule there will be a mail steamer arriving at and departing from New York every day in the year, and there will be a bi-weekly passenger and freight service from each of the ports of Baltimore and Boston

THE LAKE ERIE STEAMBOAT WESTERN STATES.

The Eastern and Western States.

The accompanying illustration of the *Western States* was taken of this new steamer while on her regular service between Detroit and Buffalo. This steamer, with her sister ship, the *Eastern States,* was turned out the beginning of the summer from the Detroit Shipbuilding Company. The distance between the cities of Buffalo and Detroit is 260 miles, of which about 60 miles is shoal water, necessitating slow speed. The remainder of the trip, however, is run at full speed, or about 20 miles per hour. Nightly service between the two cities is maintained by these two vessels.

The ships are identical in every particular, the general dimensions being as follows:

Length over all	366 ft. 0 in.
Length of keel	351 " 0 "
Beam	45 " 0 "
Beam over guards	80 " 0 "
Depth	19 " 6 "
Draft	12 " 0 "

The general style of the interior arrangement is similar to the latest Long Island Sound steamers, and the cabins are very handsomely finished. There are two complete passenger decks, with the quarter deck and cabin aft. Freight and express packages are carried on the main deck forward.

As will be noted in the picture, the ship is propelled by paddle wheels of small diameter. The principal dimensions of the engine, which is an inclined compound, are: 52 inches diameter of high-pressure cylinder, 72 inches diameter of low-pressure, each working on a separate crank with a common stroke of 84 inches. The wheels have feathering buckets 4 feet wide by 13 feet long and are 25 feet in diameter. The main shaft is supported by 6 journals. The crank shaft is 18 1-2 inches in diameter and the wheel shafting 20 1-4 inches. There are six single-end Scotch boilers, 13 feet long and 13 feet 6 inches diameter, with a total grate surface of 275 square feet. The Howden system of forced draft is used.

These vessels were designed by Mr. Frank E. Kirby, who is at present preparing designs for two passenger and freight vessels similar to, but larger than, the above.

Navy Estimates for 1904.

In the Navy estimates for the year 1904, recently made public by the Secretary of the Navy, the total amount to be asked for is $82,426,030.58, of which $28,024,872 is for the expense of new construction, distributed as follows:

Construction and machinery	$15,025,632
Armor and armament	10,000,000
Equipment	400,000
Two steel training ships, sail	750,000
One wooden brig, training vessel	50,000
Miscellaneous—	
Buildings at Naval Academy	1,250,000
Construction work, Washington Navy Yard	498,740
Improvements, Indian Head proving ground	50,500
Total	$28,024,872

This does not include the sum of $21,386,533, which is the estimate for the Bureaus of Yards and Docks, Equipment, Construction and Repair, and Steam Engineering.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 123 vessels of 43,743 gross tons built in the United States and officially numbered during the month of September, 1902. The largest steel steam vessels included in these figures are: *Finland,* 12,760 gross tons; *Texan,* 8,633 gross tons; *Frank H. Goodyear,* 4,815 gross tons.

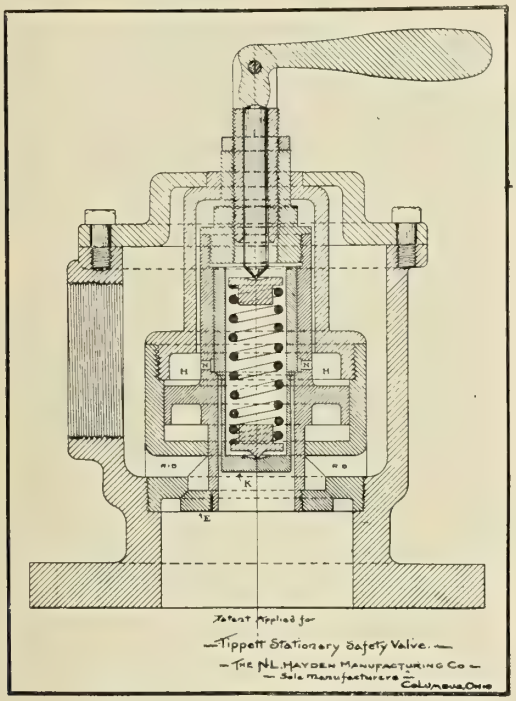
Oil Tanks.—Because of numerous complaints of weak fuel tanks on board steam vessels about San Francisco harbor, the local inspectors have issued a circular stating that fuel oil tanks for marine purposes must be made of 1-4-inch material for vessels navigating inland waters, and 5-16-inch for sea-going vessels. Rivet holes shall be drilled and all seams double riveted.

Electric Power in English Shipyards.—The city of Sunderland, which is the headquarters for one of the largest shipbuilding districts in Great Britain, has decided to build a large electric-power plant for furnishing electricity to shipyards of that locality. Current is to be generated at 550 volts and supplied at low pressure to the works from sub-stations. The cost of the undertaking will be in the neighborhood of $300,000.

ENGINEERING SPECIALTIES.

A Compact Safety Valve.

Safety valves are generally made to depend upon the tension of a heavy spring for operating, and the amount of the opening of the valve is generally limited by this spring tension. The accompanying illustration shows a valve which is built on a different principle in that the main valve is operated by a small secondary valve which is controlled by a light spring. The valve opens with promptness and without any increased resistance. Referring to the sectional cut here given: Steam rises against the lower end of the adjusting valve, *K*, which is held to its seat by the tension of spring *M*, which is set to the required pressure; when this pressure is reached, adjusting valve *K* opens and allows the steam to escape through the ports *N*, *N* into the chamber *H*, against the top of the main valve,



A COMPACT SAFETY VALVE.

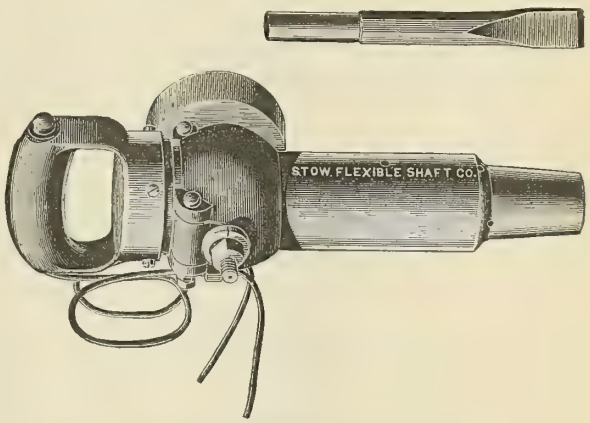
E. This downward pressure opens the main valve and the boiler is relieved. When the boiler pressure decreases to such an extent that spring *M* closes adjusting valve *K*, then the steam coming through the ports *N*, *N* is shut off, and the main valve, *E*, closes.

Any desired amount of opening of the main valve is obtained, which prevents any increase of pressure over the popping point. Thus, it will be seen, the operation of the main valve is positive, the force holding it to its seat increasing as the pressure rises, until the release point is reached. The pressure can be released without reseating the valve for the purpose of blowing off or for making repairs, washing out, etc., by relieving the light tension of the small spring, which is adjusted by the handle at the top. This valve, called the Tippett Safety Valve, is made by the N. L. Hayden Manufacturing Company, 108 West Spring street, Columbus, O.

Portable Electric Hammer.

The electric hammer which is here illustrated is making a good record for itself as a labor saver. It is stated that it is fitted for all classes of work now done by pneumatic hammers, such as chipping iron or steel in foundry work, bridge building, calking of boilers, structural iron, shipbuilding, etc.

The main points claimed for this portable electric hammer are the simplicity of construction; efficiency and durability; no plant is required, as the current may be taken from any electric power from 110 to 500 volts; economical operation; transportation of power a great distance with practically no loss.



PORTABLE ELECTRICALLY-DRIVEN HAMMER.

Another advantage is that the electric hammer may be used in the coldest weather, as, of course, there is no danger of its freezing when out of doors as sometimes occurs with the pneumatic tools.

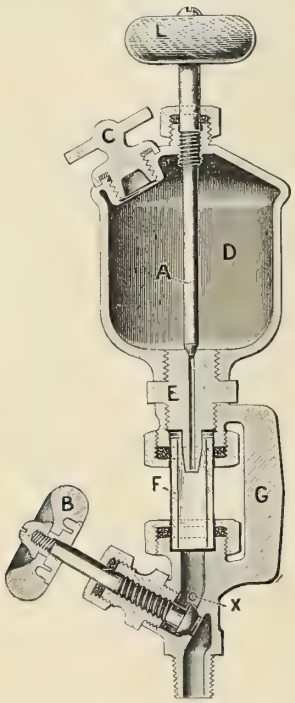
There are three sizes of hammers: No. 1, for stone carving; No. 2, for medium chipping, calking, and light riveting; and No. 3, for heavy chipping and riveting. When no current is obtainable a small 1 horse-power electric generator, capable of running three hammers, may be installed at small expense. Inquiries concerning this hammer, which is called the Jackson portable electric hammer, should be addressed to the Stow Flexible Shaft Company, Twenty-sixth and Callowhill streets, Philadelphia.

Automatic Sight-Feed Graphite Lubricator.

With the use of high steam pressures and superheated steam, oil as a lubricator is not entirely satisfactory. Powdered graphite has long been known as a superior lubricant, having the peculiar quality of working itself into the superficies of the cylinders and valves of steam pumps and engines, giving them a highly finished surface, thus reducing the friction and requiring very little oil. While graphite possesses high lubricating qualities, at the same time it is not advisable to use it alone, and good practice recommends an oil pump, or sight-feed lubrication, in addition to the graphite. When this combination is effected, it is only necessary to feed about one-third as much oil as when no graphite is used. Another valuable feature of graphite is that it fills up the crevices and interstices of the packings; thus the stuffing boxes need not be kept so tight and the

friction on the rods and valve stems is lessened. It also increases considerably the durability of the packings. While many engineers would use graphite they have found considerable difficulty in procuring suitable apparatus for feeding it to the parts to be lubricated.

The accompanying illustration is the single-connection, graphite, sight-feed lubricator which has recently been put on the market by the Lunkenheimer Company, Cincinnati, Ohio, and which is claimed to be suitable in every way for the purpose its name implies. The graphite is fed automatically and continuously in the desired quantities and is visible by passing through a sight feed. The cup requires but one connection to the cylinder and is very simple in construction.



A GRAPHITE LUBRICATOR.

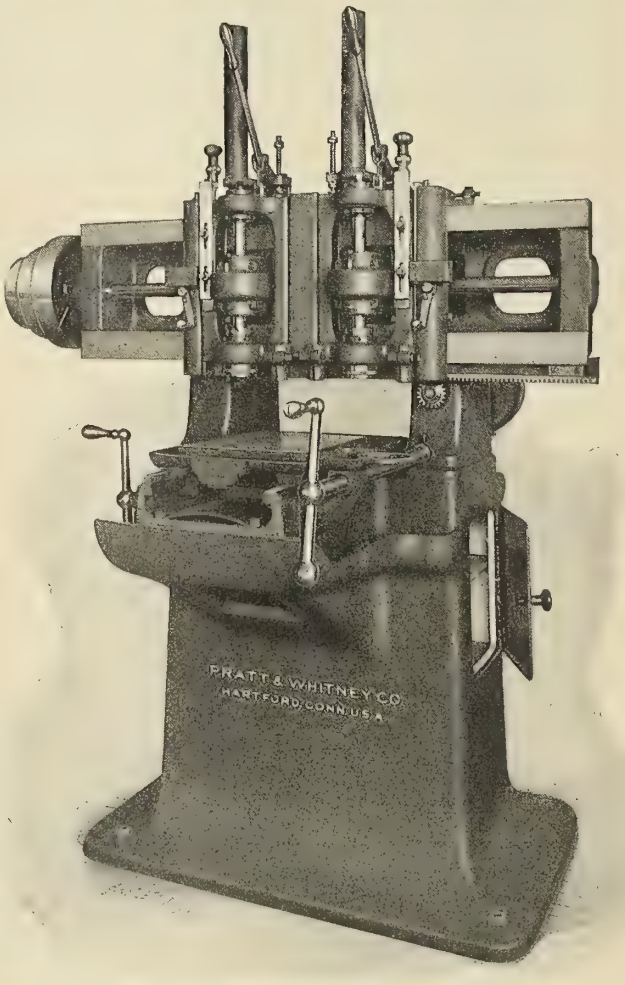
To operate the lubricator, the following points should be observed: Close steam valve *B* and open drain plug *X* to allow steam to escape from cup; then close regulating valve *A*, remove filling plug *C*, and fill cup with graphite. After replacing filling cup *C*, close drain plug *X*, open steam valve *B* (wide) and regulate feed of graphite by regulating valve *A*. The sight-feed glass can easily be cleaned by opening drain plug *X*. If necessary to replace the sight-feed glass take cup apart at *E* by means of wrench furnished, and slide the new glass down through the opening.

New Profiling Machine.

A profiling machine of entirely new design has been brought out by the Pratt and Whitney Company, Hartford, Conn. The principal feature of the machine is that it has two spindles by means of which a roughing and finishing milling cut may be taken in one setting of the piece.

The accompanying half-tone illustration gives an excellent idea of the appearance of the machine.

The column is heavy and provides a rigid support for the working parts above and contains two tool cabinets and a tank for oil or soda water. The table is held down to the bed by two straps, is guided by a single V of ample dimensions and rests upon a flat track to the right. Each spindle is driven by means of a line-contact spiral gear and pinion with liberal tooth contact and ample wearing surfaces. The gear is made from a steel casting and the pinion of phosphor bronze. They are enclosed in a tightly-fitted casing filled with a suitable lubricant. Both gear and pinion have their hubs journaled in bearings independent of the driving shaft and



A NEW TWO-SPINDLE PROFILING MACHINE.

spindle bearings, leaving the spindles free and sensitive, and permitting close adjustment with respect to tooth contact. The gear is driven by two long keys located in the driving shaft opposite each other. The driving cone pulley is counterbalanced and is journaled on the outside of the driving shaft bracket, leaving the shaft free from all strain due to the belt pull.

Ball thrust bearings are provided at each end of both the gear and pinion, permitting the spindle to be rotated with equally good results in either direction and producing a very free-running and durable drive.

The spindles are made of steel, are ground, and run in bronze bearings. The lower bearings are solid and conical in form, while the upper bearings are of cylin-

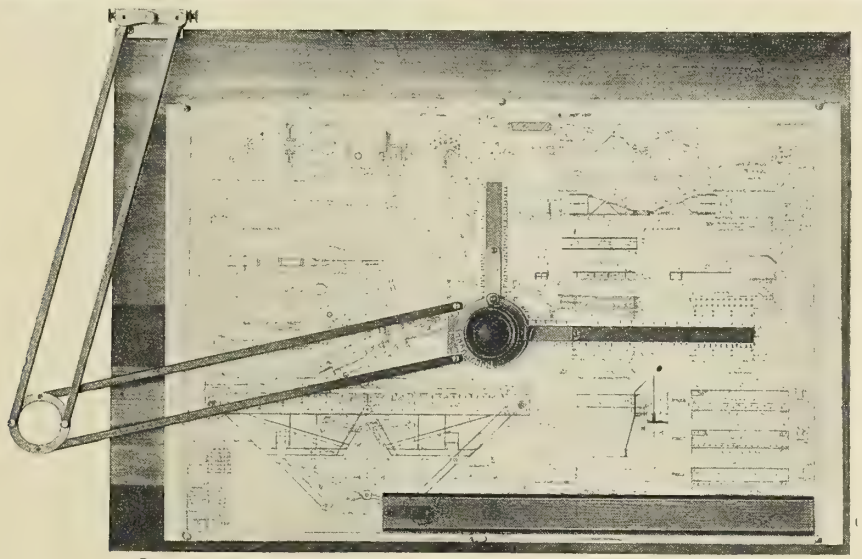
drical form and are split. Both are provided with suitable adjustment for wear. The end thrust at the lower bearing is taken by a babbitt-metal washer. If desired, the spindles may be run at 1,200 revolutions per minute.

The spindles are regularly fitted with Jarno taper, but special tapers may be furnished to order.

When not in use, each head is held in a raised position by a heavy enclosed spiral spring, yet may be readily lowered by a hand lever and clamped in any desired position. A lock bolt engaging a slot in the adjustable bar is provided for properly locating the head, and a screw with micrometer dial facilitates the close adjustment of the bar. The position of the head may also be determined by the adjustable stop located at the top.

The gearing for operating table and crosshead is so constructed as to permit all back-lash being taken up by means of double gears and double racks, so arranged that one part may be adjusted in relation to the other part, so that the teeth of each part do not exactly line up, but do fill the space of its mating rack or gear. When properly adjusted the two parts of the member may be firmly clamped together by conical studs.

The right-hand spindle head is provided with an extra former pinhole located on the opposite side of the spindle from that in which the pin regularly fits. The centers of the two holes are located equidistant from the center of spindle and in the same plane with it. In order to produce a profiling former plate directly from a model piece of work, the latter may be fastened to the table in position where the work regularly rests, and the blank former plate fastened to the position in which the finished former is afterward to be used. With the former pin in the extra hole the blank may be profiled.



A NEW DRAFTING MACHINE.

Universal Drafting Machine.

The machine here illustrated is a decided innovation for use in a drafting room, and, as a substitute for the T square and triangles, goes a long way in saving time. As drawings are now made, a line is drawn with one edge, and this edge has to be removed and another taken up in order to scale off the proper distance. This changing from one edge to another is certainly not direct, and where it occurs so many times during the day involves the loss of much time.

The Universal Drafting Machine, here illustrated, can be used for drawing parallel lines at any angle on the paper, and lines perpendicular to them, and for measuring the line as it is drawn. The little machine consists of a graduated square having an accurate parallel motion about the drawing board. The square is adopted because the work of most drawings consists of sets of lines at right angles. Both blades of the square are graduated for measuring the lines as they are drawn and are interchangeable for those of any length or any scale, and when inking is to be done a straight-edge is supplied. The parallel motion is obtained by means of two pivoted parallelograms, which constitute an arm joining the square to the board. This arm is flexible, so that the blades may lie flat upon the drawings; and it is also hinged at the connection to the board, so that it may be lifted out of the way of the paper. It may be readily changed from one board to another. A conical adjustment is provided to take up any lost motion.

Placed upon the ring is a conveniently-adjusted protractor, which allows the square to be quickly set at any angle. Thus angular work is made as rapid, easy, and accurate as straight work. Spring stops at 30, 45, and 60 degrees are provided, allowing the square to be instantly set at these frequent angles.

Summing up the advantages of this machine, they are, that the lines are drawn and scaled with the same edge and at the same time, and angular work is as easy as straight work. The machine is being manufactured and sold by the Universal Drafting Machine Company, Blackstone Building, Cleveland, O.

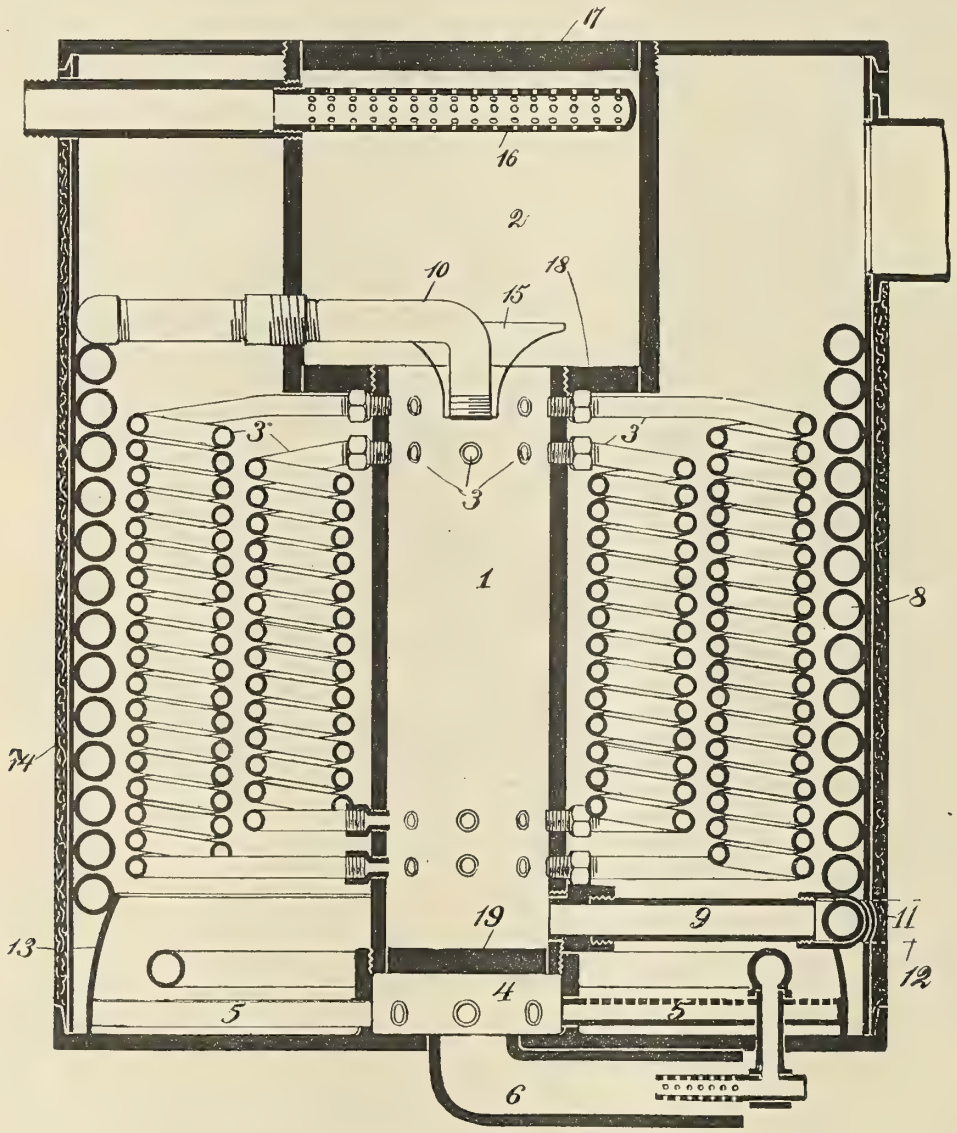
The Salamandrine Boiler.

A boiler which has sustained very many severe tests, and which it is claimed will not explode and will not be burned out, has been placed on the market by the Salamandrine Boiler Company, 220 Broadway, New York.

The boiler is adapted for launches and automobiles and can sustain high pressures.

The novel feature consists primarily in surrounding the main water and steam-containing and steam-generating portions of the boiler by a closely-coiled water tube of 7-8 inch diameter, so connected with the other parts of the boiler as to form a portion of the circulation system and to act as a wall to confine the heat from the burner, so that it will circulate most effectively against a double series of enclosed smaller coils of generating pipe and reduce the radiation of heat from the outer shell of the boiler. To further aid this purpose, the feed water is admitted first into this outer coil and caused to circulate in such a way that this tube is constantly the coldest part of the boiler. Another object accomplished at the same time is the gradual heating of the water in this tube before it enters the central and more highly-heated parts of the boiler, thus avoiding the injurious effects of cold water in a boiler.

The boiler comprises a central water chamber or column 1, a superposed steam dome 2, a double or triple series of helically-coiled generating pipes 3, connected at their upper and lower ends with the water column and arranged at a slight angle from the perpendicular, the surrounding coil of larger pipe 8, a baffle plate 15, a separator 16, a series of radial gas tubes 5, constituting a burner, a curved collar or guard 13 to direct the combustion within the outer coil of pipe, and a boiler shell enclosing the entire construction.



SECTION OF THE SALAMANDRINE BOILER.

The end of the upper pipe 10 projects into the top of the water column and is bent downwardly, so that the water from it pours downwardly and away from the dry steam pipe 16. The water column is closed at the bottom by a plate 19 of steel welded in, and at its upper end is screwed into a similar plate 18, welded into the lower end of the steam dome, the top of which is entirely closed by a welded-in plate 17. The feed-water pipe 12 is connected at 11 with the enclosing coil pipe by means of a T connection in such a way that the entering current of cold water will be in axial alignment with

the end of the coiled pipe and at right angles to the radial pipe 9 that connects with the bottom of the water column. Thus the force of the water from the feed pipe assists in the circulation from bottom to top of the pipe coil that is set up by the heat, and at the same time draws into the coil with it hot water from the bottom of the water column, thus partially heating itself.

At 4 is a distributer for the gas, from which it passes through a system of radial tubes closed at their outer ends and perforated on their upper sides to form a burner. The gas enters this distributer from the pipe or mixing tube 6 beneath, into the end of which projects the nozzle from the vaporizer. This nozzle is connected with the end of a vaporizing tube that passes around three-quarters of the arc of a circle just above the burner and then is downwardly turned through the bottom of the boiler to connect with the fuel supply.

The base of the boiler is made integral with the metal flange of the distributing chamber for the gas and with the mixing tube. These may be removed by simply unscrewing the flange from the bottom of the water column. The encircling pipe coil can also be removed by unscrewing one pipe connection at the lower end and another at the upper end, thereby rendering it a simple matter to get at the interior to remove and replace any of the inner coils if necessary.

The inner generating coils are arranged at a slight angle from the vertical to more effectively utilize the ascending heat. As the burner is composed of a number of separate short tubes, it is a very simple matter to replace any of them that may become defective.

Meeting of the Society of Naval Architects and Marine Engineers.

The tenth annual meeting of the Society of Naval Architects and Marine Engineers will be held at 12 West Thirty-first street, New York city, on November 20 and 21, on which dates the following technical papers will be read:

Thursday, November 20.

1. "Technical Training for Shipbuilders." By Henry S. Pritchett, LL.D.
2. "Progressive Trials of the Screw Ferryboat *Edgewater*." By Edwin A. Stevens, Vice-President, and Charles P. Paulding, Junior.
3. "Why It Takes So Long to Build and Equip a Naval Vessel for the United States." By George W. Dickie, Member of Council.
4. "The Preliminary Official Trial of the U. S. Battleship *Maine*." By Assistant Naval Constructor J. W. Powell, U. S. N., Associate.
5. "The Water-tube Boiler in the American Mercantile Marine." By Wm. A. Fairburn, Member.
6. "Longitudinal Bending Stress on Damaged Ships." By George C. Cook, Member.
7. "Some Problems on the Surfaces of Buoyancy and of Waterlines." By Professor Cecil H. Peabody, Member of Council.
8. "Experiments and Formulæ on the Strength of Ships' Beams." By K. G. Meldahl, Naval Architect, Germany.

Friday, November 21.

9. "Vibration of Steamships; with Special Reference to Those of the Second and Higher Periods." By Rear Admiral George W. Melville, Engineer-in-Chief, U. S. Navy, Vice-President.
10. "The Development of Modern Ordnance and Armor in the United States." By Rear Admiral Charles O'Neil, Chief of the Bureau of Ordnance, U. S. Navy.
11. "Remarks on the New Designs for Naval Vessels." By Rear Admiral Francis T. Bowles, Chief Constructor, U. S. Navy, Vice-President.
12. "The Tactics of the Gun." By Lieut.-Commander Albert P. Niblack, U. S. Navy, Associate.
13. "The Possible and Probable Future Developments in the Use of Electricity on Board Ships." By F. O. Blackwell, Esq.
14. "Submarine Boats; Their Present Development and Future Possibilities in Naval Warfare." By Lawrence Y. Spear, Member.
15. "Measurement Rules for Yachts; with Special Reference to Racing Conditions." By F. W. Belknap, Esq.
16. Prize Competition Paper.

QUERIES AND ANSWERS.

Q. 106 *a*.—Why is a four-cycle gasoline engine more economical than a two-cycle?

b.—Why is the rub, and hammer break, used on marine engines almost exclusively, and the jump spark on automobiles?

c.—Would not the jump spark work satisfactorily on a marine engine?

A.—(*a*) The four-cycle engine is usually more economical than the two-cycle of the enclosed-crank-case type, because the four-cycle usually employs a higher compression. By some authorities the difference has been attributed to the escape of a portion of the unburned mixture through the exhaust passages, and by others to the high percentage of burned gases remaining in the cylinder. In a well-designed two-cycle engine there should be very little difference between its fuel consumption and that of the four-cycle. On the very large two-cycle engines used in Germany for sizes ranging in the neighborhood of 500 to 1,000 horse power the two-cycle is found to be the more economical type. These engines, however, are of a somewhat different type than the enclosed-crank-case engines used on marine work in this country. (*b*) The question would have been better put if it had been, Why is the jump spark used on automobiles? Answering this form of the question, the automobile engines run at very much higher speed than the hammer break will give good service. As the automobile engine runs at a great many different speeds, it is necessary to change the lead of the igniter to get the best results for the various speeds, and this can be more conveniently done with the jump spark than with the other type. However, the hammer break is not confined to the marine engine, nor the jump spark to the automobile, as the reader will find by reference to Mr. Roberts' article in the August issue. (*c*) The article referred to above answers this question.

Q. 109.—Where are the perpendiculars located in drawings of steamships? J. C. C.

A.—The term "perpendiculars" has reference to the dimension "length between perpendiculars." The location of the perpendiculars between which this length is measured varies in different countries and with different types of vessel. In the United States the after perpendicular is located at the after side of the stern post, while the forward perpendicular in planked ships is located where the water line cuts the forward edge of the stem rabbet, while in iron ships it is located where the water line cuts the forward edge of the stem. The horizontal distance between these two lines is then called the "length between perpendiculars."

Q. 111.—Will you kindly answer in your valuable inquiry column the following question, which has more or less caused considerable expression of difference of opinion, viz.: What is the theoretical definition of a fraction of a pitch, the angle of the screw, and the length of the screw? H. W. J.

A.—We assume that in the inquiry you refer to a screw propeller. In the first place, you ask for a theoretical definition. There is no such thing. A definition is a brief description or characterization of the thing defined. It is neither theoretical nor practical; it is a definition.

"The term "fraction of pitch" applied to the screw propeller usually relates to the length of the blade fore and aft. Thus if the pitch is 16 feet, while the greatest fore-and-aft dimension of the blade is 2 feet, the fraction of the pitch actually employed in one blade is one

eighth. Thus in Fig. 1 we have the side view of a propeller blade. Then the extreme distance, AC, between the forward and after edges would be the fore-and-aft length of the blade, and this divided by the pitch would give the fraction of pitch.

To define the angle of a screw, imagine a cylinder of any given radius to intersect the propeller face. The line of intersection will be a part of a curve known as a helix. Then suppose the cylinder cut along an element parallel to the axis and rolled out flat, or "developed," as it is termed. In Fig. 2 let $ABCD$ represent this development, AB being the element parallel to the axis. Let PQ be the development of the helix resulting from the intersection of the surface of the

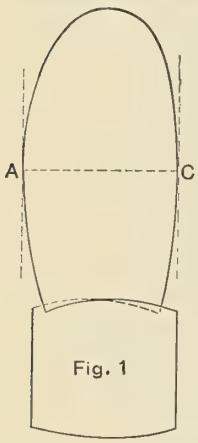


Fig. 1

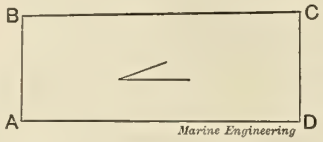


Fig. 2

cylinder with the propeller, and PR a line parallel with AD. Then the angle at P is the angle of the screw. It is easily seen that this angle varies continuously from hub to tip of blade, and without we know the radius at which it is taken the term "angle of screw" has no significance or value. With the radius it is easily shown that the value of the pitch is given by the equation:

$$p = 2\pi \quad r \tan \alpha$$

where p = pitch, r = radius, and α = angle.

By the term "length of screw" we suppose the fore-and-aft dimension is meant, as shown by AC in Fig. 1.

Oil for Torpedo Boat.—The torpedo boat *Talbot* is to be equipped with an oil-fuel-burning plant and sent to sea for a trial. Rear Admiral Melville is desirous of learning whether or not this fuel can be used on the naval ships satisfactorily.

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 348 sail and steam vessels of 103,421 gross tons built in the United States and officially numbered during the quarter ended September 30, 1902. During the corresponding quarter ended September 30, 1901, 393 sail and steam vessels of 68,395 gross tons were built in the United States and officially numbered.

Steam Yacht Helena.—From the premises of the Eastern Manufacturing Company, South Brewer, Me., the steam yacht *Helena*, belonging to Mr. Fred. W. Ayer, of that company, was recently launched. The vessel is 108 feet long over all, 91 feet 8 inches long between perpendiculars, 17 feet beam, and 10 feet 4 inches deep. Every part of the vessel was built by the above-mentioned company's mills.

TECHNICAL PUBLICATIONS.

Materials of Machines. By Albert W. Smith. Size 5 by 7 1-2 inches, pp. 142, with 17 figures and diagrams. John Wiley and Sons, New York. Price $1.

The author, in his preface, states that this book is the result of an effort to bring together concisely the information necessary to him who has to select materials for machine parts. The material is presented in five chapters dealing with the metallurgy of iron and steel, the testing of materials and stress-strain diagrams, cast iron, wrought iron and steel, alloys.

The author is thoroughly at home in his subject, both as a practical and experienced designer of machinery and as a teacher acquainted with the needs of students and the general reader seeking information in this field. He has succeeded most admirably in bringing together into a concise and convenient form a large amount of the most valuable information for all who are concerned with the metals chiefly used for engineering purposes. The style is simple and clear, the illustrations such as are needed to aid the text, and the book is a thorough success. It is brief, concise, and to the point, and contains the information which the average engineer will most need in connection with his intelligent selection of materials for various engineering purposes. The presswork and binding are in the well-known standard text-book style of the publishers.

Hawkins Emett, Diagramal Formulæ. Size 9 by 12 inches. Twenty-four blue-print plates, with leather cover. W. H. Collier Publishing Co., 234-235 Broadway, New York. Price $3.

This book consists of twenty-four formulæ worked out in diagram form and arranged conveniently for use by draftsmen, designers, and engineers. The formulæ cover the ordinary field of stationary steam-engine design and are intended to represent the best modern practice in standard construction of this type. Each sheet contains a statement of the operation required, with an illustrative example. One peculiar feature of the diagrams consists in the fact that the result to be obtained is not directly represented by the scales on the diagram, but is to be measured by a scale or rule applied to the diagram itself. In this way the diagrams are somewhat simplified, but it may be questioned whether their use would not have been a little readier with a self-contained scale for the result.

This collection of diagrams would be improved by an appendix showing just what formulæ are employed, what constants are used, what coefficients of safety are included, and in general by showing the engineering foundation of the diagrams and rules presented. As it is, the designer must either blindly accept the rule and result given by the diagram, or he must figure backward from the diagram to the formula in order to be able to form any independent judgment regarding its applicability to the circumstances of the case in hand.

Collections of diagrams of this kind are of great help to those who may not be able to derive formulæ for themselves or judge regarding their use in any given instance, and also to all who may have taken the trouble to test their character and establish to their own satisfaction the basis upon which they are developed. For the trained designer they will hardly be satisfactory without some means of enabling him to judge regarding their applicability to his problems, or to modify them

in accordance with his judgment. He will not care to follow blindly the dictates of a rule or diagram the character or foundation of which is not clearly manifest.

With such additions as to show clearly the foundation of the various diagrams, the acceptability of the book would be much enhanced. As it is published the lack of such explanation will be likely to render the book less acceptable to the large body of designers who do not wish to work blindly and who are accustomed to employ judgment as well as methods of computation for the determination of their structural details and dimensions.

Submarine Warfare, Past, Present, and Future. By Herbert C. Fyfe. Size 5 1-2 by 9 inches, pp. 332. With 50 illustrations. Price $3. E. P. Dutton and Co., London and New York.

The apparent present-day interest in submarine boats and submarine warfare, and the lack of a popular work in the English language relating to these subjects, are the reasons which have induced the author to prepare this work. The introduction to the book is written by Admiral Fremantle, and a chapter on the probable future of submarine boat construction by Sir Edw. J. Reed. The subject matter of the book is presented in three parts, consisting, first, of a general discussion of the subject of submarine warfare; second, of a general history of the development of submarine navigation; and, third, of a series of appendices giving more detailed information regarding recent designs and construction in Europe and America. The subject is purposely treated in a popular rather than a purely technical manner, while at the same time a large amount of information is given regarding the design and characteristics of the latest types of submarine construction. In the chapter on the mechanism of the submarine the author gives an interesting discussion on the various means available for propelling submarine boats, as well as for exercising the necessary control when submerged. Various problems of stability, control, respiration, safety, habitability, armament offensive and defensive, are given a due share of consideration. The historical development of the subject gives evidence of wide reading and a careful selection of the material available. The work of the early inventors in this field is given due recognition, while naturally the chief attention is paid to the developments of recent years, and to the types of submarine boat which may properly be called modern. The Holland submarine boat naturally comes in for the most complete description, while at the same time suitable recognition is given to the Lake submarine and also to the early efforts of Bushnell, Fulton, and others in the United States. Similar description is also given to the various European designs in the same field, and the designs proposed more especially in France and Spain are described with like completeness.

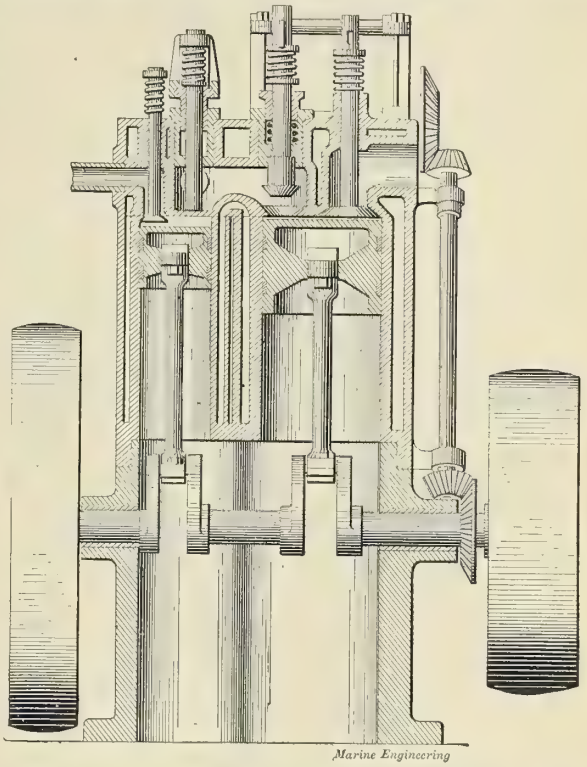
As a whole, this book will prove a very acceptable addition to the literature of marine warfare and will be found of great interest not only to those who are technically concerned with naval warfare in its various aspects, but also to the general reader who is desirous of acquainting himself with the history of this type of marine construction, with a fair statement of its possible relation to the art of naval warfare, and with the developments along these lines during the past decade.

SELECTED MARINE PATENTS.

708,153. OAR ATTACHMENT. MONS A. LINDER, PULLMAN, ILL. Six claims.

708,227. STEAM TURBINE. ROBERT B. HEWSON, SAN FRANCISCO, CAL. Seven claims.

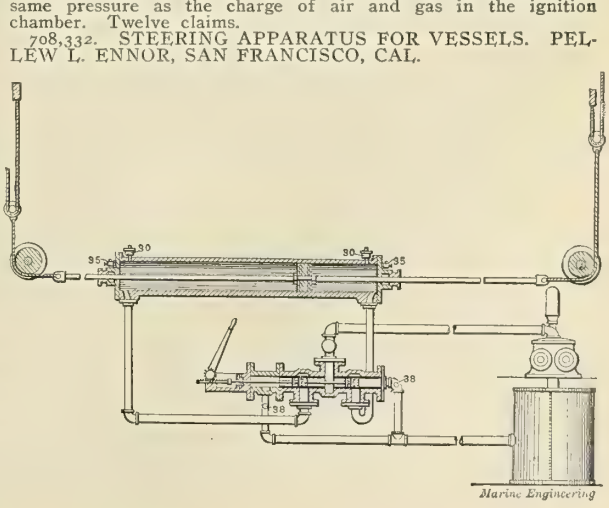
708,236. GAS ENGINE. WILLIAM A. LEONARD, WAREHAM, MASS.



Marine Engineering

CLAIM.—1. In a gas engine, a power cylinder, a pump cylinder, a single cylinder head for both said cylinders, an inlet port, leading through the cylinder head and opening into the end of the pump cylinder, an exhaust port for the power cylinder, also extending through the cylinder head, an ignition chamber in said cylinder head and having communication with each cylinder, a puppet valve controlling the inlet port to the pump cylinder, a second puppet valve controlling the exhaust from the power cylinder, a third puppet valve controlling the communication between the pump cylinder and the ignition chamber and a fourth puppet valve controlling the inlet between the ignition chamber and power cylinder, all of said valves being carried by and operating in the cylinder head, and each of said valves being independent from the others and when closed having its face flush with and constituting part of the end of the cylinder, positive valve-actuating mechanism for the valve controlling the inlet to the power cylinder and that controlling the exhaust therefrom, said mechanism operating to close the inlet valve at the finish of the outward stroke of the power piston, and also operating to close the valve in the exhaust port before the power piston reaches the end of its inward stroke, whereby the gases remaining in the power cylinder are compressed to substantially the same pressure as the charge of air and gas in the ignition chamber. Twelve claims.

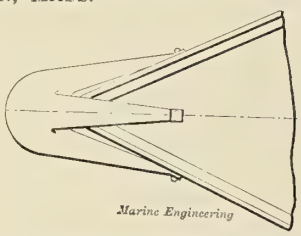
708,332. STEERING APPARATUS FOR VESSELS. PELLEW L. ENNOR, SAN FRANCISCO, CAL.



Marine Engineering

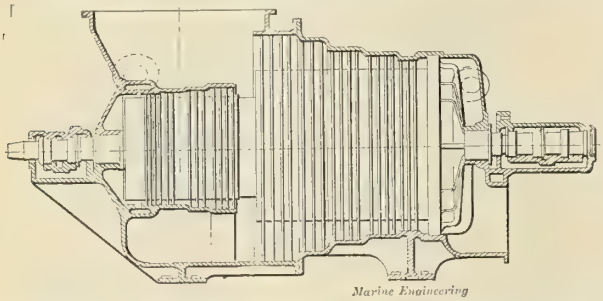
CLAIM.—In hydraulic steering apparatus, the combination of a main steering cylinder provided with air-escape valves 30 and water-escape valves 35, a controlling cylinder provided with air-inlet valves 38, a force pump for maintaining pressure in the system, a tank for receiving the circulating liquid, a pipe from the pump to the controlling cylinder, return pipes from the controlling cylinder to the tank, and pipes from the controlling cylinder to the main steering cylinder. One claim.

708,476. FENDER FOR BOATS. WILLIAM H. HIGGINS, BOSTON, MASS.



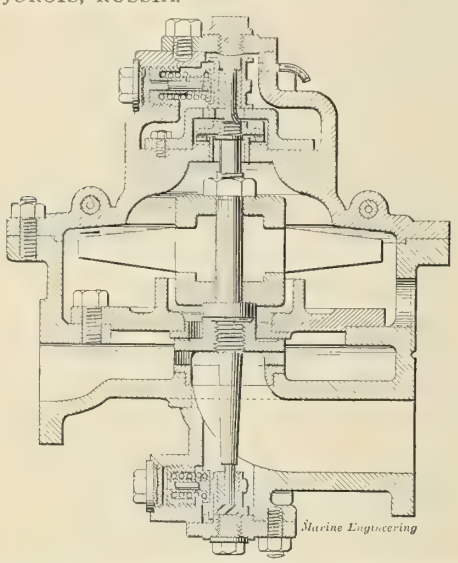
CLAIM.—1. A fender for boats consisting of two flexible triangular members sewed together around their edges, stuffing between them, means for securing the prongs to the boat, and a web for attaching the center of the device to the boat, as and for the purpose set forth. Four claims.

708,780. STEAM TURBINE. CHARLES A. PARSONS, NEWCASTLE-UPON-TYNE, ENGLAND.



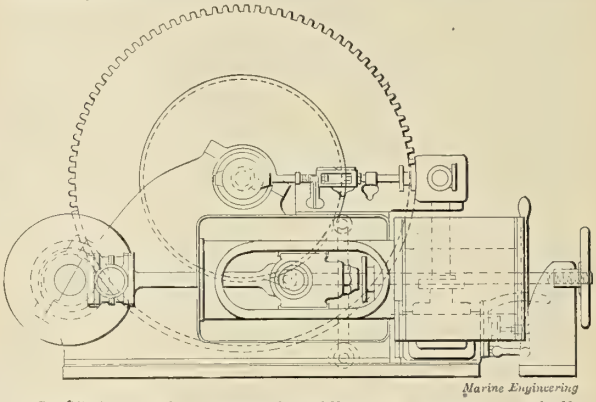
CLAIM.—1. In parallel-flow turbines, in combination, a complete main turbine having its own casing and its own drum and having a plurality of rings of blades supported from said casing and a plurality of interspaced rings of blades supported from said drum, an exhaust passage leading from said main turbine, a complete reversing turbine having its own casing and drum and having a plurality of rings of blades carried by the casing and a plurality of interspaced rings of blades supported from the drum, said turbines being mounted on the same shaft, and the exhaust end of the reversing turbine being connected with the said exhaust passage from the main turbine inside the main turbine casing. Four claims.

708,815. STEAM TURBINE. ALBERT KRANK, WARKAUS JOROIS, RUSSIA.



CLAIM.—1. In steam-jet turbines, the combination, with an enclosing casing a rotary shaft passing through the interior of the casing, bearing boxes located at each end of the casing to receive the ends of the shaft, means for supporting and permitting the bearing boxes to have motions in directions parallel with the axis of the shaft, spring-actuated devices for normally maintaining the bearing boxes coincident with the axis of the casing, a steam-jet turbine wheel fixed on the said shaft, a chamber in the casing within which chamber the wheel is located, jet nozzles entering the turbine-wheel chamber to deliver the steam jets to the vanes of the wheel, and a steam-exhaust aperture to the said wheel chamber; of a second chamber within the casing through which also the turbine shaft passes, a dividing wall between the chambers, devices for preventing intercommunication of the contents of the chambers by leakage around the shaft and for permitting the elastically-held rigid shaft to have automatic lateral adjustment so that it may assume its natural axis of rotation, a centrifugal pump disk fixed on the shaft within the second chamber, a fluid-supply passage to the centrifugal pump disk by which fluid is pumped into the second chamber and maintained at pressure therein, and an exit pipe from the second chamber by which the pressure fluid is conveyed for either direct utilization or for driving secondary machinery. Five claims.

708,818. WINDLASS. FRANK S. MANTON, PROVIDENCE, R. I.



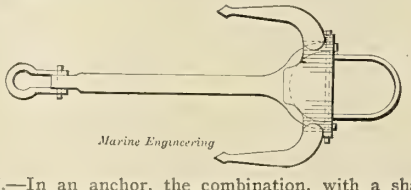
CLAIM.—1. An automatic riding or anchorage windlass equipped with surge-relieving mechanism and comprising a main shaft serving as a valve-actuating shaft, an engine, an engine shaft geared to the main or valve-actuating shaft, a pressure valve having means controllable by said valve-actuating shaft to vary the fluid pressure in the engine, a wildcat or chain wheel mounted directly and loosely on the valve-actuating shaft and capable of turning freely thereon in paying out the anchor chain, and a clutch for making said wildcat fast directly to the valve-actuating shaft and causing the latter to directly transmit the strain to the engines and to actuate the pressure valve. Five claims.

709,861. CUTTER HEAD FOR HYDRAULIC DREDGES. LINDON W. BATES, CHICAGO, ILL. Fourteen claims.

710,054. DREDGER AND EXCAVATOR. ISAAC B. HAMMOND, PORTLAND, OREGON.

CLAIM.—1. The combination with the dredge ladder and the tumblers for the dredge chain, of an endless dredge chain and buckets; traveling carriers therefor, attached below the chain and narrowed toward the base, so that such carriers in width occupy only a portion of the space within the span of the buckets; a railed way extending the length of the upper surface of the ladder leading from and to the tumblers; a railed way extending from the upper tumbler along the under surface of the ladder for a part of its length, being disconnected at a convenient point, allowing enough of the dredge chain and buckets at the lower end of the ladder to hang free, to provide sufficient drag; and a guard for holding the chain carriers traveling along the railed way on the under side of the ladder against a lateral thrust or strain, the tumblers being adapted to allow the traveling carriers to pass between their sides while the chain passes over their rims. Six claims.

710,167. ANCHOR. JAMES A. PETTES, GRAND MANAN, CANADA.



CLAIM.—In an anchor, the combination, with a shank, of a ring pivoted to the lower end of the shank and having scoop-shaped projections on its upper edge, and flukes having curved lower portions which project laterally from the sides of the said ring between the scoop-shaped projections, and flukes being arranged at a greater distance from the shank than the said projections and terminating in barbed points. One claim.

710,275. LIFE PRESERVER. CHARLES HUNT, BELFAST, IRELAND. FILED NOV. 15, 1901. Two claims.

Tremont's Speed.—The steamship *Tremont*, which arrived in San Francisco on September 24, made the trip from New York around the Horn in 54 days, or at an average speed of 12.35 knots. The *Tremont* was built by the Maryland Steel Company for the Boston Steamship Company, and with the other vessels of this fleet will be used in the Asiatic service.